ASIC Framework for EdTech Optimisation

### Joshua O. Owolabi

###### About the Idea

About ASIC Framework: Excerpt

The use of innovations and educational technologies or EdTech has become integral to medical education, and advancement in healthcare. Currently, EdTech variants are quite diverse, with significant variations in EdTech penetration and qualities of deployment from place to place. Through experience, observations, research and synthesis of evidence, four key considerations for optimizing innovations and educational technologies [EdTech] when used for medical and higher education [MedEd] have been established as follows- adaptation, standardization, integration and compliance [ASIC]. The instrument has been named ASIC Framework which can be practically applied using its operational matrix. Subsequently, the ASIC Framework has become a foremost instrument for *assuring* innovation and EdTech’s optimisation for medical education, health science education and by extension, higher education. Maladaptation of a new technology might be significantly counterproductive just as lack of standardization might be problematic as it causes heterogeneities. Also, poor integration might make the use of an innovation negatively disruptive. Lack of compliance might introduce extreme relativism in EdTech use philosophy, and unethical practices. The ASIC Framework was originally developed, published and presented to the communities of practice. Also, a practical guide named ASIC Framework Operational Matrix was published to aid the practical use of the framework. Subsequently, this matrix has been digitalized and made available in the form of a web-hosted app, hence, an innovative product that could be patented. The ASIC Framework could be very useful to key stakeholders in medical education including educators, institutions and regulators. Ultimately, it could generally and universally help to optimize the use of technologies and innovations for medical education and training, and by extension, higher education.

2024

Department of Biomedical Sciences, PCOM South Georgia,

2050 Tallokas Road,

Moultrie, GA 31768.

7th August, 2024.

The Provost, SVP for Academic Affairs, Philadelphia College of Osteopathic Medicine, Philadelphia, Pennsylvania.

USA.

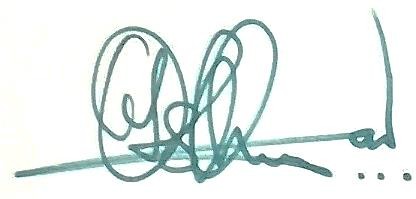
Dear Dr. Veit,

Re: A Decision About my Invention Named ASIC Framework for EdTech Optimization

I write to request a decision about my invention named: ASIC Framework for EdTech Optimization, that was submitted to the Philadelphia College of Osteopathic Medicine in May 2024, especially indicating PCOM’s position about the ownership of the invention and submission of a provisional patent application.

I specially appreciate you and the leadership of the PCOM for the attention given to my submission. I have benefited from the enriching conversations and critique of the idea and the actual product that I am presenting for a patent. Altogether, I greatly appreciate the thoroughness of the PCOM process of consideration and the positive disposition of all stakeholders and university officials, including yourself as the Provost and SVP for Academic Affairs, Dr. George- Weinstein as the PCOM Chief Research Science Officer, and the team that was set up to review the submission during my presentation. I am also very grateful to the President, Dr. Feldstein.

Thank you very much, sir.



**Joshua O. Owolabi** | MSc., MMedEd, MBA, PhD, PhD, FAcadMEd Associate Professor

Anatomy, Neuroscience & Histology

Integrating and Optimising Artificial Intelligence [AI] For Medical and Higher Education: Application of the ASIC (Adaptation- Standardisation - Integration- Compliance) Framework to Guide Educators and Academic Leaders.

**Joshua Oladele Owolabi**

Artificial Intelligence (AI) has rapidly transformed medical and higher education, creating unprecedented opportunities alongside significant implementation challenges. While AI's influence on educational practices was anticipated, the speed and scope of current developments have exceeded expectations, fundamentally altering not only pedagogical practices but potentially reshaping the cultural fabric of higher education institutions. This radical transformation has left many educators unprepared, as most lack formal training in AI-enabled pedagogy despite growing pressure to integrate these technologies effectively. The educational community currently exhibits a polarized response spectrum ranging from resistant skepticism to uncritical enthusiasm. Many educators struggle to apply sound pedagogical principles when deploying AI tools, while institutions lack consensus on evidence-based frameworks for systematic implementation. This heterogeneity in adoption creates uneven educational experiences and risks compromising educational quality without proper guidance structures. To address these critical gaps, this article presents the ASIC (Adaptation-Standardisation-Integration-Compliance) Framework as a comprehensive solution for systematic AI integration in medical and higher education. The framework provides structured guidance across four essential domains: adapting AI tools to specific curricular objectives, standardizing implementation protocols, integrating AI with established pedagogical practices, and ensuring compliance with ethical and institutional requirements. The ASIC Framework addresses the complex ecosystem nature of educational institutions, where AI technologies interact dynamically with curriculum design, assessment methodologies, institutional policies, and cultural practices. This systems-thinking approach prevents fragmented implementation and ensures that AI deployment serves broader educational missions while maintaining academic integrity and professional standards. Through systematic application of ASIC principles, educators can evaluate AI innovations using measurable effectiveness indicators, align technological adoption with evidence-based pedagogical theories, and create sustainable integration strategies that evolve with advancing technologies. The framework's emphasis on compliance ensures ethical AI deployment while addressing critical concerns about algorithmic bias, data privacy, and academic integrity. This comprehensive approach offers medical and higher education institutions a practical pathway toward thoughtful AI integration that prioritizes learner outcomes and professional competence development over technological novelty, ultimately supporting the transformation of educational practices through evidence-based, pedagogically sound implementation strategies.

**Key terms:** AI, Medical education, Higher Education, ASIC, Framework, Adaptation, Standardisation, Integration, Compliance

1. Background

Artificial Intelligence (AI) has increasingly permeated and influenced global education ecosystems, shaping both pedagogical practices, curriculum delivery and institutional cultures. In medical and higher education, AI has significantly enhanced digital transformation by providing powerful tools for adaptive learning, assessment automation, resource creation and adaptation, and instructional support. However, these developments are quite rapid to allow for proper alignment with educational best practices and they often appear uneven across educational ecosystems. This problem of uneven application of edtech and innovations coupled with a lack of internal and cross-institutional standardization has been termed *heterogeneity* [1]. Faculty responses to AI use range from skepticism and resistance to enthusiastic adoption, albeit, with a significant proportion of educators lacking formal training in AI-enabled pedagogy. The resulting heterogeneity highlights an urgent need for structured frameworks to guide AI adoption responsibly and effectively. Building on earlier scholarly work, this article presents the ASIC Framework as a practical and theoretically grounded guide for integrating and optimising AI in medical and higher education [2] [3]. This article addresses AI use contexts that involve specific use of AI resources for learning or teaching, such as generative large language model AI including ChatGPT, Google Gemini, Claude, or educational AI resources; it does not necessarily apply to AI as used in enabling existing major technologies or when used for non-learning or teaching purposes.

1. AI for Medical and Higher Education: Opportunities, Challenge, Matters Arising and Application of the ASIC Framework

The adoption of AI in education presents a multi-dimensional narrative of opportunities, challenges, and matters arising. AI, based on practical applications, reported users’ experiences and scholarly evidence in publications, has offered great opportunities to both learners and educators. Leaders, administrators, and staff in academia have also benefited from AI use. Clearly, one could posit that AI has brought immense opportunities. Nonetheless, reports and experiences about fallouts or unintended consequences have equally presented stakeholders with not only concerns but also significant challenges, particularly those that border on ethics, academic integrity, data protection, and matters of effectiveness and educational value of AI products in medical and higher education. Clearly, while opportunities need to be harnessed to further advance educational practices and better support learners and trainers, the challenges equally warrant attention, and they need to be properly and effectively addressed, such that fallout and unintended consequences of AI use would not erode the benefits. Concurrently, there are now matters arising that warrant urgent and adequate collective attention and effort to address them, from all stakeholders, some of which are highlighted below (See Table 1).

* + **Opportunities**: AI tools provide personalised instructional design, dynamic digital learning resources, intelligent tutoring systems, and advanced assessment analytics. They enhance access to knowledge, support complex simulation environments, and foster reflective practice [4].
  + **Challenges**: AI raises questions of ethics, integrity, bias, academic rigour, and the risk of cognitive complacency. Without deliberate frameworks, AI risks eroding critical thinking skills and widening inequities [3].
  + **Matters arising**: Regulatory, national and institutional policies on AI remain fragmented, and many governments or institutions are still developing guidelines and

policies. Faculty therefore need internal institutional frameworks to anchor decision- making on AI use [5]. They also need a framework to determine the educational value of AI use.

**Table 1**: AI use in Medical and Higher Education with an emphasis on Curriculum, Pedagogy Assessment, the Learner and the Ecosystem of education. The table has a list of opportunities for AI use in the contexts of Curriculum, Pedagogy, Assessment, the Learner and Educational Ecosystem. In each of this category, challenges and matters arising bordering on ASIC i.e. Adaptation-Standardisation-Integration-Compliance are also highlighted. (A- Adaptation; S- Standardisation; I- Integration; and C- Compliance). Citations are provided for 12 top identified opportunities about AI use as it pertains to Curriculum [6, 7], Pedagogy [8, 9] Assessment [10,

11]; the Learner [4,6, 12] and the Ecosystem [12, 13].

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | **Curriculum** | **Pedagogy** | **Assessment** | **Learner** | **Ecosystem** |
| **Opportunities** | 1. **Curriculum design** - AI- assisted curriculum development for educational programs 2. **Curriculum review** - Analysis and optimisation of existing curricula 3. **Curriculum mapping** - Intelligent visualization and alignment of learning milestones 4. **Curriculum translation to learning outcomes and didactic content** - Generating high-level specific objectives and measurable outcomes 5. **Course design** - AI- enhanced design of course structures and sequences of implementation   .   1. **Course review** - Systematic review and evaluation of course for improvement or effectiveness 2. **Competency gap analysis** - Identification of | 1. **Instructional design** - AI- enhanced design or optimization of learning experiences tailored to pedagogical principles 2. **Resource sourcing and citation** - Automated identification and integration of relevant scholarly sources 3. **Multimodal content presentation** - Dynamic creation of visual, auditory, and interactive learning materials 4. **Adaptive learning systems** - Personalized instruction that intelligently calibrates to individual learning needs, levels, styles and pace 5. **AI-based virtual patient simulations** - AI-enabled realistic clinical scenarios and simulations. 6. **Intelligent tutoring systems** - 24/7 personalized | 1. **Question creation - MCQs** – AI-   enabled generation of multiple-choice questions with validated distractors, appropriate rationale and calibration to program and board standards.   1. **Essays** - AI- assisted creation and evaluation of written assessment. 2. **Case**   **development** - Generation of realistic clinical scenarios for problem-based assessments   1. **Grading agent**   - Automated scoring with standardized rubric-based feedback   1. **Agentic assessors** - Bias-free evaluation systems for objective grading 2. **Feedback aggregator and provider** - Comprehensive analysis and delivery of structured constructive feedback 3. **Adaptive testing platforms** - | 1. **Agentic tutors**   - AI companions that provide personalized learning support, coaching and mentorship   1. **Personalized learning** – AI- enabled customized educational experiences based on individual needs and preferences 2. **Learning style adaptation** - AI systems that adjust content delivery to match cognitive and content modality preferences 3. **Progress tracking and analytics** - Accurate monitoring and analysis of learning achievements and areas for improvement 4. **Remediation support** - Targeted interventions for students struggling with specific concepts and skills 5. **Career guidance and planning** - AI- enabled counsellor on academic and professional development | 1. **Efficient content creators and curators** - Automated creation, curation and management of educational resources 2. **Auto-responders chatbot or agent**   - Intelligent communication systems for student queries and support   1. **AI data analysts and agentic auditors** - Comprehensive analysis of educational effectiveness, performances and outcomes 2. **Report generators** - Automated creation of institutional or student performance reports 3. **Learning management system integration** – Incorporation of AI tools into existing educational platforms 4. **Resource allocation optimization** - Intelligent distribution and management of educational resources and facilities 5. **Faculty development** |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | curriculum inherent knowledge, skills and professional competences.   1. **Learning pathway optimization**   - AI-enabled personalized sequencing of educational materials and millstones.   1. **Cross- institutional benchmarkin g** of **curriculum** - Comparative analysis and standardization of curricula across different institutions 2. **Accreditation compliance mapping** – AI- enhanced automated verification of curriculum alignment with accreditation standards 3. **Dynamic curriculum updating** - Real-time integration of current medical knowledge and practices 4. **Interdisciplin ary curriculum integration** - Effective integration of multiple- discipline materials and training. | academic or learning support and guidance   1. **Gamification elements** - AI- generated or powered edutainment and interactive challenges 2. **Real-time learning analytics** - Continuous monitoring and optimization of learning effectiveness 3. **Collaborative learning facilitation** – AI-moderated educational projects and peer interactions 4. **Scaffolding and cognitive load management**    * Intelligent guidance for learning based on complexity of the learning materials 5. **A Socratic questioning system** – AI- guided engagement through discovery-based learning 6. **AI-Enabled Immersive VR/AR**   **educational environments**   * + Enhanced presentation of learning materials and concepts; skill- based learning | Dynamic and intelligent adjustment of question difficulty based on performance   1. **Competency- based assessment mapping** - Alignment of assessments with specific competencies 2. **Formative assessment optimization** - AI-enabled learning-driving continuous low- stakes assessments and feedback. 3. **Scenari os**-**based assessment creation** - Development of real-world assessments, based on scenarios 4. **AI-**   **Based OSCE and oral examinations**  - AI-facilitated oral exam and OSCE based on standardized rubrics   1. **Portfoli o assessment analytics** – Comprehensive objective analysis of student work over time | 1. **Study schedule optimization** - Intelligent time management and learning planner. 2. **Peer matching for collaboration** - AI-facilitated academic partnership with compatible study partners 3. **Motivation and engagement enhancement** – Customized adaptive systems that maintain student interest and effort 4. **Accessi bility support** – Intelligent AI tools that accommodate diverse learning needs and disabilities 5. **Langua ge learning assistance** - Specialized and customized language support assistant for   non-native language users.   1. **Wellne ss and mental health and monitoring system**- AI- enabled wellness monitor and advisor; detection of stress and burnout with appropriate interventions | **and training** - AI- enabled professional development for educators   1. **Institutional decision support** – AI-enabled data- driven insights for academic leadership and policy-making 2. **Quality assurance and compliance monitoring** – Intelligent automated tracking of educational standards and regulations 3. **Cross- institutional collaboration platforms** - AI- enabled collaboration and resource sharing systems including multiple language adaptations. 4. **Predictiv e analytics for student success** - Early identification of at-risk students and intervention strategies 5. **Educatio nal research and innovation hubs**   - AI-powered platforms for advancing medical education science |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Challenges** | **A**- How to use the most appropriate AI program for appropriate curriculum activities.  **S** - How to hold users accountable to similar standards that meet program and/or professional requirements.  **I** - How to establish equitable and standardized access to AI for curricular activities, using similar methods and levels of applications.  **C** - Proper use of AI in line with program requirements and standards. | **A** - How to ensure that AI resources are used according to program requirements.  **S** - How to ensure that high quality, principle-based and pedagogically sound practices are consistently applied with each use of any eligible AI product.  **I** - How to ensure proper and equitable access to AI resources across all parts of the educational context as applicable and in sustainable ways.  **C** - How to ensure that AI use properly aligns with institutional, programmatic, and professional or work-related standards and ethics. | **A** - How to make AI create, implement or grade assessment activities in ways that meet program, institutional and training requirements.  **S** - How to ensure that AI use is consistently adequate in line with program, institutional and professional or work-related standards.  **I** - How to ensure consistent performance and of desirable quality with every AI use for assessment activities.  **C** - How to ensure that AI- generated, facilitated or conducted assessment activity meets all key applicable assessment criteria such as validity, reliability, acceptability, practicality, appropriateness etc. as well as programme, institutional, and professional standards. | **A** - How to ensure that learners are properly using AI resources to accomplish learning goals that satisfy cognitive, affective, psychomotor and professional expectations.  **S** - How to ensure that methods and goals of AI use meet educational requirements, consistently.  **I** - How to ensure that AI use consistently serves educational values and can be continually adjusted for optimal application, in line with personal needs and ecosystem culture.  **C** - How to ensure that learners are using AI to enhance learning and optimize experiences in compliance with ethics, learning principles and program, institutional and professional standards, policies and practices. | **A** - How to provide the most suitable AI products and ensure that they work with the learning and institutional system dynamics.  **S** - How to define acceptable practices for AI use and determine that only those that meet educational standards are deployed for standard educational activities using guidelines and policies..  **I** - How to make quality AI products available and promote quality practices, make products function effectively within the ecosystem, and promote equitable access to all learners and users in the educational ecosystem.  **C** - How to ensure that there are practical, adequate, timely and effective policies, standards and benchmarks and to ensure adherence to them using tools, and corrective feedback loops. |
| **Matters Arising** | **A** - Applying AI appropriately for | **A** - Proper application of | **A** - Align AI- enabled | **A** - Train learners on | **A** - Ecosystem culture should |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | curricular enhancement, management, and implementation with clear adequate guiding principles.  **S** - Setting quality standards for AI use with established principles that are consistently applied.  **I** - Properly deploying AI within the educational ecosystem to support curriculum related activities including management, mapping and translation of curriculum templates into actionable learning and teaching activities including but not limited to curriculum mapping, learning outcome or objective optimization and curriculum alignment with institutional, broad or professional standards.  **C** - Ensuring that AI use properly enhances curricular delivery without compromising learning outcomes, | learning theories and pedagogical principles to support AI use for learning activities.  **S** - Providing frameworks, guidelines and principles for AI use for learning and teaching.  **I** - Defining the roles of AI use in learning and setting standards or benchmarks.  **C** - Providing measures of accountability for AI use for learning activities and means of assuring accountability. | assessment methods and activities with other methods or types of assessment.  **S** - Setting clear measures for determining assessment quality in the context of AI use for assessment and ensuring consistent application of the same.  **I** - Developing practices of AI- enabled assessment as cognizant and appropriate components of assessment types, practices or measures of competencies.  **C** - Assuring alignment of AI- enabled practices with program, institutional and professional standards using guidelines, principles, ethical frameworks and professional requirements. | proper AI use for educational activities and indicate acceptable use and context of applications.  **S** - Provide guidelines on acceptable AI use and practices and maintain standard approaches consistently in all contexts of learning and training.  **I** - Make AI function properly within the ecosystem; make access consistently and equitably possible; indicate context of use and application.  **C** - Provide clear principles and guidelines including measures of accountability and modes of encouragement or reward for best practices and deterrence for unethical and wrongdoing practices. | suitably adjust to embrace and enable AI use; practices should make provision for AI use with emphasis on ethics and best practices.  **S** - Standard approaches for AI use by learners, educators, staff and community members should be clearly stated, reinforced and consistently maintained.  **I** - Standard institutional AI products should be specified and made available, with clear guidelines for use and best processes.  **C** - Institutions need to have quality, timely and effective AI policies, guidelines for ethical and acceptable practices with emphasis on learning and professional conduct. |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | training- associated competencies and professional developmental milestones; aligning AI use with curriculum philosophy, didactic content delivery, institutional policies and programme or professional standards. |  |  |  |  |

1. ASIC Framework and Its Application for Integrating and Optimising AI For Medical and Higher education

The ASIC Framework- Adaptation, Standardisation, Integration, and Compliance- was developed to provide educators with structured guidance for deploying educational technologies and innovations [1, 14, 15, 16]. Its application to AI provides a systematic pathway for educators to evaluate and optimise AI tools in their teaching and learning environments. This framework could address the rapid, albeit heterogenous or random AI adoption in medical education [17]. The key tenets of the ASIC Framework (originally applied to EdTech in general), now adapted more specifically to AI use in medical education are highlighted below:

1. **Adaptation:** AI use should be embedded into curricula and learning activities in ways that serve specific programme objectives. Adaptation requires that faculty and academic leaders consider context, learner readiness, and institutional culture. For example, the use of AI-driven anatomy atlases should align with pre-clinical learning outcomes and be adapted to complement existing laboratory teaching.
2. **Standardisation:** To avoid fragmented practices, AI use must be supported by protocols, guidelines, well formulated practical policies, and instructional design principles. Standardisation ensures that AI adoption is evidence-based and consistent with established pedagogical principles. Faculty should create reproducible methods for AI use, such as clear protocols for integrating AI-powered assessment analytics into formative and summative evaluations.
3. **Integration:** AI should not operate in isolation but must be interwoven into the broader pedagogical framework. Integration emphasises synergy between AI and other instructional strategies and resources across different levels and disciplines. For example, AI-enabled diagnostic simulations can be integrated with case-based learning and interprofessional education to create authentic learning experiences.
4. **Compliance:** AI use must adhere to institutional standards, ethical guidelines, and regulatory requirements. Compliance involves ensuring that AI applications uphold academic integrity, protect learner data, and align with professional accreditation

standards. This includes adopting ethical AI practices, mitigating bias in algorithms, and ensuring transparency in assessment tools.

The original ASIC framework was created to be a practical guide that could be specifically applied by educators and academic leaders to not only determine the educational value and potential impact of any teaching innovation or EdTech but also measure the same qualitatively and quantitatively. This approach requires answering specific questions that further prompt quality reflections thereby guiding educators to making informed decisions. There are 12 questions in total equally distributed across the key aspects of adaptation, standardization, integration and compliance equally. As a rule, a potentially impactful educational technology including AI should score a minimum of two out of three in each ASIC tenant category. While it might not be a best practice to not have absolute performance scores across all ASIC tenants, allowing for the use of an innovation that has scored two out of three in each category equally provides opportunity for educators to engage in further reflection to address areas of weaknesses identified through the reflective process and generated by their application of the ASIC framework on the entire framework. In fact, it is naturally required that educators undertake a reflective process that guides them to fix any deficiency identified through the ASIC Framework deployment.

More specifically in this case, when AI is already in use and educators or institutional stakeholders would want to use the ASIC Framework to determine the educational impacts, the Framework would engender the reflective practice that could help to come up with solutions to the identified areas of deficiency and to improve opportunities for the optimal educational value and impacts of the AI resource of choice. The version of the ASIC Framework, according to its tenets as applicable to AI use in medical education is presented below (this application is specifically adapted to the use of LLM, Generative AI resources as currently used in medical and higher education) (Table 2). The table has the tenets and the associated key questions including prompts (i.e. probing questions) that might further guide educators or other ASIC Framework users on how best to answer the questions of the ASIC Framework. Also, a complete ASIC Framework questionnaire for AI use in medical education, ready for use by educators is also provided as Appendix 1.

**Table 2:** ASIC Framework and Tenets including corresponding questions for determining AI educational value and potential impacts. The table also includes prompts (probing questions for further guidance) and additional timelines.

|  |  |  |
| --- | --- | --- |
| ASIC Tenet | Additional Prompts | Note |
| **Adaptation**   * **Consideration**: The use of AI is indicated in the curriculum/syllabus (i.e. there is a specified time/period/duration for AI- supported activities).   + Yes ☐ No | C- Al: Is this technology/innovation clearly indicated as a learning tool/facility in your curriculum, syllabus or lesson plans? | Curriculum adaptation Q1 (C-A1) demands that the curriculum or its derivatives- sulalabi, etc., indicate how AI resources should be used. |
| * **Consideration**: AI tools are deployed to achieve stated learning objectives (i.e. there is a clear objective statement that aligns with AI use in teaching or training).   + Yes ☐ No | P- A2: Is the use of the technology or innovation aligned with specifically stated learning objective[s]?  A- A3: Is there an | Pedagogy- Adaptation Question, Q2 (P-A2) demands that AI use should be justified by its capacity to help accomplish specific learning objectives.  Assessment- Adaptation Question, Q3 (A-A3) |

|  |  |  |
| --- | --- | --- |
| * **Consideration**: The impact of AI on learning outcomes is measured with formative/summative assessments (i.e. AI- enhanced learning outcomes are identified and assessed).   + Yes ☐ No | indicated assessment | demands that AI use |
| method that is used to | should align with |
| measure the impact[ s] of | program or institutional |
| the technology or | assessment standards, |
| innovation on learning | practices, or methods. |
| outcome, as measured |  |
| with |  |
| formative/summative |  |
| assessments? |  |

|  |  |  |
| --- | --- | --- |
| ASIC Tenet | Additional Prompts | Note |
| **Standardisation**   * **Consideration**: Time allocation for the use of AI tools is indicated in the curriculum/syllabus (i.e. there is a specific time/period allocated for AI-supported learning).   + Yes ☐ No * **Consideration**: The method of AI use is pre-determined and a protocol/guide is prepared (i.e. a standard operating procedure or instructional design plan exists for AI use).   + Yes ☐ No * **Consideration**: AI-supported activities are aligned with specific objectives that are also measured or assessed (i.e. objectives are defined and linked to assessment criteria).   + Yes ☐ No | C- S1: Is there a specific time allocation or unit allocation for the use of the technology in your curriculum or syllabus?  P- S2: Is there a planned or standardised method of using the technology or innovation. e.g. learning protocol or learner’s guide?  A- S3: Is the technology or innovation as used involved in the formative or summative assessments? | Curriculum Adaptation Question, Q1 (C-S1) demands adequate measures are taken to determine learning activities supported by AI, the place of AI use in the curriculum and appropriate time allocation.  Pedagogy- Adaptation Question, Q2 (P-S2) demands that a template of instructional design and facilitation be provided for an AI- enabled learning and teaching activity in a programme.  Assessment- Adaptation Question, Q3 (A-S3) demands that evidence of alignment, practicality, and attainment of specific learning objectives with AI be provided. |

|  |  |  |
| --- | --- | --- |
| ASIC Tenet | Additional Prompts | Note |
| **Integration**   * **Consideration**: Specific competencies to be achieved with AI are identified in the **curriculum**/syllabus (i.e. AI-supported sessions contribute directly to programme competencies).   + Yes ☐ No | C- I1: Is there any specific competencies to achieve with the technology/innovation as indicated in the curriculum or syllabus? | Curriculum Integration Question, Q1 (C-I1) demands that AI use correlates with the accomplishment of identified learning outcomes, and programme related competencies or appropriate learning milestone |
| * **Consideration**: The use of AI tools aligns with established pedagogy and learning | P- I2: Is the use of the technology or innovations in alignment with known | Pedagogy- Integration Question, Q2 (P-I2) |

|  |  |  |
| --- | --- | --- |
| theories (i.e. AI deployment follows **pedagogical** principles and lesson planning).   * Yes ☐ No * **Consideration**: Assessment of AI- supported learning contributes to final measures of training impact (e.g. AI- informed **assessments** or analytics are factored into grading or evaluations).   + Yes ☐ No | pedagogy or pedagogical principles?  A- I3. Is there an assessment of learning with innovation or technology that contributes to measures of training impacts? | demands that AI use is supported by clearly defined sound pedagogical principles that could help with consistency and sustainable impacts that are integral to the programme..  Assessment- Integration Question, Q3 (A-I3) demands that AI enabled assessments meet programme and institutional requirements and professional or regulatory standards. |

|  |  |  |
| --- | --- | --- |
| ASIC Tenet | Additional Prompts | Note |
| **Compliance**   * **Consideration**: The use of AI aligns clearly with the **curriculum** philosophy and/or programme objectives (i.e. there is evidence of institutional compliance).   + Yes ☐ No | C-Cl: Is the use of the technology or innovation in alignment with identified institutional curriculum philosophy and/or objective? | Curriculum Compliance Question Q1 (C-C1) demands that AI use supports curriculum philosophy and aligns with programme and institutional policies. |
| * **Consideration**: AI adoption is consistent with institutional or programme philosophies on **pedagogy** and teaching methods (i.e. evidence of policy and standard-practice compliance exists).   + Yes ☐ No | P-C2: Is there a learning theory, pedagogical principle or a professional practice that supports the use of the technology or innovations? | Pedagogy- Compliance Question, Q2 (P-C2) demands that AI use for learning and teaching aligns with policies and guidelines or protocols approved for the programme. |
| * **Consideration**: The **assessment** and evaluation of AI’s impact on learning aligns with institutional and/or regulatory requirements (i.e. ethical, accreditation, and cultural compliance are demonstrated).   + Yes ☐ No | A- C3: Is the use of the technology or innovations and its impacts on learning in alignment with programme and/or regulatory requirements as measures of competences. | Assessment- Compliance Question, Q3 (A-C3) demands AI use comply with programme, institutional and professional requirements and standards of acceptable assessment processes and practices. |

1. Discussion

The integration of AI into medical and higher education cannot be left to spontaneous adoption, enthusiasm, random implementation or individual experimentation. Without guiding frameworks, AI risks creating inconsistencies, ethical dilemmas, and misalignments with educational goals. The ASIC Framework addresses this gap by offering a structured, theory- informed, and evidence-based approach. Its emphasis on adaptation, standardisation, integration, and compliance aligns with established learning theories such as adult learning

theory, cognitive load theory, and Bloom's taxonomy [17]. Furthermore, the operationalisation of ASIC through digital tools and assessment matrices enables faculty to evaluate AI innovations with measurable indicators of effectiveness [4, 7, 18].

The current landscape of AI adoption in educational institutions shows a concerning pattern of heterogeneity that undermines the potential benefits of these technologies. Faculty responses range from complete resistance to uncritical enthusiasm, with many educators lacking formal training in AI-enabled pedagogy [19, 20, 21]. This disparity creates an uneven educational experience where students may encounter vastly different levels of AI integration across courses, institutions and countries. The ASIC Framework addresses this challenge by providing standardised criteria that ensure AI deployment serves specific programme objectives while maintaining pedagogical integrity. By requiring evidence of curriculum alignment, learning objective achievement, and measurable outcomes assessment, the framework helps prevent ad hoc implementation that may compromise educational quality or create inequitable learning experiences [5, 22].

The ethical dimensions of AI integration in medical and higher education demand particular attention, especially given the high-stakes nature of medical education, healthcare training and professional development. Issues of bias in AI algorithms, data privacy concerns, and the potential for cognitive complacency among learners require systematic consideration rather than reactive responses [23, 24, 25]. The compliance component of the ASIC Framework specifically addresses these concerns by mandating alignment with institutional and professional standards, ethical guidelines, and regulatory requirements. This proactive approach ensures that AI adoption upholds academic integrity, protects learner data, and maintains transparency in assessment tools. Moreover, the framework's emphasis on professional, regulatory or accreditation standards helps institutions navigate the complex regulatory landscape surrounding AI use in healthcare education [26, 27, 28].

The pedagogical implications of AI integration extend beyond mere technological adoption to fundamental questions about the nature of learning as well as knowledge acquisition, construction and application in professional education. The ASIC Framework's integration component recognizes that AI tools must work synergistically with established educational practices rather than replacing them wholesale. This perspective aligns with constructivist learning theories that emphasise the importance of scaffolded learning experiences and authentic problem-solving contexts [29, 30, 31]. For example, AI-enabled diagnostic simulations may be more effective when integrated with case-based learning and interprofessional education, creating more authentic learning experiences that prepare students for real-world clinical practice. The framework's requirement for pedagogical alignment ensures that AI deployment enhances rather than undermines critical thinking skills and clinical reasoning competencies [32, 33].

The institutional transformation required for effective AI integration presents both opportunities and challenges that extend beyond individual classroom applications. Educational institutions have to develop comprehensive policies, invest in faculty development, provide infrastructure to support AI-enabled learning environments or similar EdTech and innovative educational methods [34, 35, 36]. The ASIC Framework provides institutional leaders with a decision-making tool that balances innovation with accountability, ensuring that AI adoption aligns with broader educational missions and values. This systematic approach helps institutions avoid the fragmented implementation that often characterizes educational technology adoption, where individual faculty members pursue isolated initiatives without institutional coordination. The framework's emphasis on standardisation and compliance creates a foundation for sustainable AI

integration that can evolve with technological advances while maintaining educational quality [37, 38, 39].

The future implications of systematic AI integration in medical and higher education suggest a paradigm shift toward more personalised, adaptive, and data-driven educational experiences. However, this transformation must be guided by evidence-based frameworks that prioritise educational outcomes over technological novelty [36, 40, 41]. The ASIC Framework's focus on measurable indicators of effectiveness provides a foundation for ongoing evaluation and improvement of AI applications in education. As AI technologies continue to evolve, the framework's adaptable structure allows for continuous refinement while maintaining core principles of educational quality and ethical practice. Ultimately, the success of AI integration in medical and higher education will depend not on the sophistication of the technology itself, but on the thoughtfulness and rigor with which it is implemented within established educational frameworks that prioritise learner outcomes and professional competence [42, 43, 44, 45].

There is a need to consider an institutional educational system as a learning or educational ecosystem, especially when deploying technologies and innovations including AI [6]. The integration of AI into medical and higher education demands an ecosystem approach that recognises the complex interdependencies between technological, pedagogical, and institutional components. Educational institutions function as dynamic ecosystems where AI technologies interact with curriculum design, pedagogical practices, assessment methodologies, institutional policies, and cultural practices in ways that can either enhance or undermine educational effectiveness [46, 47, 48]. Drawing from ecological systems theory, successful AI integration requires understanding these multifaceted relationships and designing interventions that account for systemic effects rather than isolated technological implementations. The ASIC Framework aligns with this ecosystem perspective by emphasising the need for AI deployment to consider not just individual learning outcomes, but also how AI tools interact with broader institutional structures, policies, and cultural norms. This systemic approach helps prevent the fragmentation that often occurs when AI technologies are implemented without adequate consideration of their effects on the broader educational environment. There are other propositions on frameworks or methodical approaches to AI integration into educational systems [49, 50, 51]. The original digital ASIC Framework [52] has been suitably adapted to AI optimisation and provided as Appendix 1. To further guide educators seeking to optimise their learners' experiences by effectively deploying AI resources, there 5 Key points about AI use in Medical and Higher Education together with 12 Practical Applications of ASIC for AI in Education in the following sections.

**5 Key points about AI use in Medical and Higher Education:**

1. AI is meant to serve the user including learners, trainees or educators
2. AI use should serve the purpose of learning by enhancing experiences, improving learning process and outcomes
3. AI does not necessarily create new forms of education but might influence practices and change the culture
4. AI use should align properly with learning theories and pedagogical principles for optimal impacts
5. Ultimately, holistic education takes place in an educational ecosystem; therefore, AI use should function within the dynamics of the educational ecosystem especially in relation to the learner and learning activities.

12 Practical Applications of ASIC for AI in Education

1. **Instructional Design**: ASIC Framework helps with embedding AI into structured lesson plans, with clear objectives and measurable outcomes.
2. **Learning Resources**: Evaluating AI-driven tools against ASIC criteria helps to ensure they support cognitive, psychomotor, and affective learning domains.
3. **Assessment**: Using AI-enabled analytics within an ASIC-guided framework helps to ensure validity, reliability, and fairness of learner evaluations.
4. **Faculty Empowerment**: With the ASIC Framework, educators are empowered through a clear methodical approach to apply ASIC principles when introducing AI into their teaching.
5. **Leadership and Governance**: The ASIC Framework can be used as a decision-making tool at institutional and policy levels to ensure coherence and accountability in AI adoption.
6. **Curriculum Mapping:** With ASIC Framework, AI can be applied for curriculum mapping, define its core targets, map its delivery with milestones and provide objective analysis of delivery milestones and measures of outcomes including time dedicated to specific educational content, concepts, competencies and subjects.
7. **Curriculum Translation and implementation:** ASIC Framework application to curriculum can prompt methodical use of AI to guide the translation of a curriculum to create high quality learning objectives and outcomes, help with proper distribution of educational content to topics and sessions and sequence the delivery appropriately.
8. **Assessment Calibration:** ASIC Framework application to AI can objectively help to calibrate assessment questions - both quantitative and qualitative, to properly align with level of advancement, appropriate milestones, and board standards.
9. **Assessment grading:** ASIC Framework application to AI can guide its calibration to grade various assessment formats, with unique advantages for qualitative assessments including orals or viva voce, OSCE, essays and live demonstrations.
10. **Standardizing Academic Support for Learners:** ASIC can guide and support how AI products can be deployed, trained, calibrated or reinforced to properly support learners for institutionally designated, personally customized learner-support methods, for example, as agentic tutors.
11. **Support for Academic Leadership:** With ASIC, academic leaders have a foremost instrument for properly evaluating AI resources and products and making informed decisions for educational AI products, and leading change with AI and similar innovations.
12. **Engineering a Sound Culture of Academic Practice:** With rapid diffusion of AI into educational practices and academic ecosystems, ASIC Framework provides a simple-to- use, practical instrument with capacity to monitor AI impacts and provide a common template of reasoning and decision-making algorithm to educators and academic leaders, learners and other stakeholders.
13. Conclusion

AI offers significant opportunities for transforming medical and higher education, yet its adoption must be guided by structured frameworks. The ASIC Framework provides a comprehensive, practical, and adaptable model for guiding faculty in the integration and optimisation of AI. By focusing on adaptation, standardisation, integration, and compliance, educators and leaders can ensure that AI contributes positively to learning outcomes, maintains academic integrity, and supports sustainable innovation within educational ecosystems. The application of ASIC to AI is therefore not only timely but also necessary for advancing responsible and effective educational practices in an AI-driven era.

**Clinical trial number:** not applicable

**Consent to Publish declaration:** not applicable

**Ethics and Consent to Participate declarations**: not applicable

**Data Availability declaration**: All data analyzed or generated in this study are included in this article or provided in its supplementary information.

**Competing Interest declaration**: Author declares no competing interest.

**Funding Declaration**: There was no funding received for this work.

1. References
   1. [1]. Owolabi J (2023) Protocol Development for Digisection: Making a Case for Standardizing Educational Technology Use for Digital Dissection and Anatomical Studies. Cureus 15(3): e35766. DOI 10.7759/cureus.35766
   2. [2]. Wartman SA, Combs CD. Medical education must move from the information age to the age of artificial intelligence. *Acad Med.* 2018;93(8):1107–1109. doi:10.1097/ACM.0000000000002044.
   3. [3]. Masters K. Artificial intelligence in medical education. *Med Teach.* 2019;41(9):976– 980. doi:10.1080/0142159X.2019.1595557.\
   4. [4]. Chan, K. S., & Zary, N. (2019). Applications and challenges of implementing artificial intelligence in medical education: integrative review. *JMIR Medical Education*, 5(1), e13930. <https://doi.org/10.2196/13930>
   5. [5]. Wood, E. A., Ange, B. L., & Miller, D. D. (2021). Are we ready to integrate artificial intelligence literacy into medical school curriculum: students and faculty survey. *Journal of Medical Education and Curricular Development*, 8, 23821205211024078. <https://doi.org/10.1177/23821205211024078>
   6. [6]. Owolabi, J. O. (2025b). *Generative AI Integration for Enhancing Biomedical Sciences in the Context of Medical Education* [Poster presentation]. Harvard Macy Institute Executive Programme & Certification in Program for Educators, Boston, USA.
   7. [7]. Tolentino, R., Baradaran, A., Gore, G., Pluye, P., & Abbasgholizadeh-Rahimi, S. (2024). Curriculum frameworks and educational programs in artificial intelligence for medical students, residents, and practicing physicians: a scoping review. *JMIR Medical Education*, 10, e54793[.](https://doi.org/10.2196/54793) <https://doi.org/10.2196/54793>
   8. [8]. Janumpally, R., Nanua, S., Ngo, A., & Youens, K. (2025). Generative artificial intelligence in graduate medical education. *Frontiers in Medicine*, *11*, 1525604. <https://doi.org/10.3389/fmed.2024.1525604>
   9. [9]. Ros, M., Neuwirth, L. S., & Prasolova-Førland, E. (2025). Editorial: Redefining the pedagogy in virtual and augmented reality in medical science education. *Frontiers in Virtual Reality*, *5*, 1533837. <https://doi.org/10.3389/frvir.2024.1533837>
   10. [10]. MIT Sloan Teaching & Learning Technologies. (2024, May 9). AI-assisted grading: A magic wand or a Pandora's box? [https://mitsloanedtech.mit.edu/2024/05/09/ai-](https://mitsloanedtech.mit.edu/2024/05/09/ai-assisted-grading-a-magic-wand-or-a-pandoras-box/) [assisted-grading-a-magic-wand-or-a-pandoras-box/](https://mitsloanedtech.mit.edu/2024/05/09/ai-assisted-grading-a-magic-wand-or-a-pandoras-box/)
   11. [11]. Reid M, French M, Andreopoulos S, Wong C, Kee N. AI-generated multiple-choice questions in health science education: Stakeholder perspectives and implementation considerations. Curr Res Physiol. 2025 Aug 1;8:100160. doi: 10.1016/j.crphys.2025.100160. PMID: 40799313; PMCID: PMC12340502.
   12. [12]. Sami, A., Tanveer, F., Sajwani, K., Kiran, N., Javed, M., Ozsahin, D., Muhammad, K., & Waheed, Y. (2025). Medical students’ attitudes toward AI in education: perception, effectiveness, and its credibility. *BMC Medical Education*, 25. https://doi.org/10.1186/s12909-025-06704-y.
   13. [13]. Duan, S., Liu, C., Rong, T., Zhao, Y., & Liu, B. (2025). Integrating AI in medical education: a comprehensive study of medical students’ attitudes, concerns, and

behavioral intentions.

[025-07177-9](https://doi.org/10.1186/s12909-025-07177-9).

*BMC Medical Education*, 25.

[https://doi.org/10.1186/s12909-](https://doi.org/10.1186/s12909-025-07177-9)

* 1. [14]. Owolabi J. (2021). Proposing a Framework Guide for the Integration of Educational Technologies and Innovations into the Teaching of Anatomy and Medical Sciences: The ASIC Framework. *Adv Med Educ Pract.* 2021;12:1277–1282. doi:10.2147/AMEP.S338262.
  2. [15]. Owolabi J (2022). ASIC Framework Simplified and Operationalised – An Operational Matrix for Optimising the Use of Technologies and Innovations in Medical Education. *Adv Med Educ Pract.* 13:149–156. doi:10.2147/AMEP.S351642.
  3. [16]. Owolabi J (2025). Digitized ASIC (Adaptation, Standardisation, Integration, and Compliance) Framework: An Innovation for Optimizing Technologies and Innovations for Medical and Higher Education. *Cureus.* 2025;17(1):e77191. doi:10.7759/cureus.77191.
  4. [17]. Patil, N.G., Kou, N.L., Baptista-Hon, D.T. and Monteiro, O. (2025), Artificial Intelligence in Medical Education: A Practical Guide for Educators. MedComm – Future Medicine, 4: e70018. <https://doi.org/10.1002/mef2.70018>
  5. [18]. Gordon, M., Daniel, M., Ajiboye, A., Uraiby, H., Xu, N. Y., Bartlett, R., ... & Patricio,

M. (2024). A scoping review of artificial intelligence in medical education: BEME Guide No. 84. *Medical Teacher*, 46(4), 446-470. <https://doi.org/10.1080/0142159X.2024.2314198>

* 1. [19]. Cervantes, J., Smith, B., Ramadoss, T., D'Amario, V., Shoja, M. M., & Rajput, V. (2024). Decoding medical educators' perceptions on generative artificial intelligence in medical education. *Journal of Investigative Medicine*, 72(6), 633-639. <https://doi.org/10.1177/10815589241257215>
  2. [20]. Shata, A., Hartley, K. Artificial intelligence and communication technologies in academia: faculty perceptions and the adoption of generative AI. Int J Educ Technol High Educ 22, 14 (2025). https://doi.org/10.1186/s41239-025-00511-7
  3. [21]. Alghamdi, S., & Alashban, Y. (2024). Exploring the factors influencing the adoption of ChatGPT in educational institutions: insights from innovation resistance theory. *Journal of Applied Data Science*, 5(2), 474-490. <https://doi.org/10.47738/jads.v5i2.198>
  4. [22]. Bozkurt, A., Xiao, J., Lambert, S., Pazurek, A., Crompton, H., Koseoglu, S., ... & Jandrić, P. (2023). Speculative futures on ChatGPT and generative artificial intelligence (AI): A collective reflection from the educational landscape. *Asian Journal of Distance Education*, 18(1), 53-130.
  5. [23]. Ueda, D., Kakinuma, T., Fujita, S., Kamagata, K., Fushimi, Y., Ito, R., ... & Naganawa, S. (2024). Fairness of artificial intelligence in healthcare: review and recommendations. *Japanese Journal of Radiology*, 42(1), 3-15[.](https://doi.org/10.1007/s11604-023-01474-3) <https://doi.org/10.1007/s11604-023-01474-3>
  6. [24]. Nazer, L. H., Zatarah, R., Waldrip, S., Ke, J. X. C., Moukheiber, M., Khanna, A. K., & Hicklen, R. S. (2023). Bias in artificial intelligence algorithms and recommendations for mitigation. *PLOS Digital Health*, 2(6), e0000278[.](https://doi.org/10.1371/journal.pdig.0000278) <https://doi.org/10.1371/journal.pdig.0000278>
  7. [25]. Chin, M. H., Afzal, A., Brewer, L. C., Churchwell, A., Fair, M., Fleisher, L., ... & Yancy, C. W. (2023). Guiding principles to address the impact of algorithm bias on racial and ethnic disparities in health and health care. *JAMA Network Open*, 6(12), e2345050. <https://doi.org/10.1001/jamanetworkopen.2023.45050>
  8. [26]. Celi, L. A., Cellini, J., Charpignon, M. L., Dee, E. C., Dernoncourt, F., Eber, R., ... & Park, Y. (2022). Sources of bias in artificial intelligence that perpetuate healthcare disparities—A global review. *PLOS Digital Health*, 1(3), e0000022. <https://doi.org/10.1371/journal.pdig.0000022>
  9. [27]. Palaniappan, K., Lin, E. Y. T., & Vogel, S. (2024). Global regulatory frameworks for the use of artificial intelligence (AI) in the healthcare services sector. *Healthcare*, 12(5),

562[.](https://doi.org/10.3390/healthcare12050562) <https://doi.org/10.3390/healthcare12050562>

* 1. [28]. Habli, I., Lawton, T., & Porter, Z. (2020). Artificial intelligence in health care: accountability and safety. *Bulletin of the World Health Organization*, 98(4), 251-256[.](https://doi.org/10.2471/BLT.19.237487) <https://doi.org/10.2471/BLT.19.237487>
  2. [29]. Vygotsky, L. S. (1978). *Mind in society: The development of higher psychological processes*. Harvard University Press.
  3. [30]. Gibson, D., & Jakl, P. (2023). Learning theories for artificial intelligence promoting learning processes. *British Journal of Educational Technology*, 54(4), 951- 971[.](https://doi.org/10.1111/bjet.13341) <https://doi.org/10.1111/bjet.13341>
  4. [31]. Richter, S., Giroux, M., Piven, I., Sima, H., & Dodd, P. (2025). A constructivist approach to integrating AI in marketing education: bridging theory and practice. *Journal of Marketing Education*, 47(1), 85-102. <https://doi.org/10.1177/02734753241288876>
  5. [32]. Liu, Z., Chen, J., Li, J., Zhao, P., Huang, L., Zhang, T., & Chang, S. (2025). Artificial intelligence in medical education: transforming learning and practice. *Cureus*, 17(1), e77420. <https://doi.org/10.7759/cureus.77420>
  6. [33]. de Jong, T., & van Joolingen, W. R. (1998). Scientific discovery learning with computer simulations of conceptual domains. *Review of Educational Research*, 68(2), 179-201[.](https://doi.org/10.3102/00346543068002179) <https://doi.org/10.3102/00346543068002179>
  7. [34]. Morimoto T, Hirata H, Ueno M, Fukumori N, Sakai T, Sugimoto M, Kobayashi T, Tsukamoto M, Yoshihara T, Toda Y, et al. Digital Transformation Will Change Medical Education and Rehabilitation in Spine Surgery. Medicina. 2022; 58(4):508. <https://doi.org/10.3390/medicina58040508>
  8. [35]. Pohn B, Mehnen L, Fitzek S, Choi K-E, Braun RJ and Hatamikia S (2025) Integrating artificial intelligence into pre-clinical medical education: challenges, opportunities, and recommendations. Front. Educ. 10:1570389. doi: 10.3389/feduc.2025.1570389
  9. [36]. Knopp, M. I., Warm, E. J., Weber, D., Kelleher, M., Kinnear, B., Schumacher, D. J.,

... & Turner, L. (2023). AI-enabled medical education: threads of change, promising futures, and risky realities across four potential future worlds. *JMIR Medical Education*, 9, e50373[.](https://doi.org/10.2196/50373) <https://doi.org/10.2196/50373>

* 1. [37]. Katsamakas, E., Pavlov, O. V., & Saklad, R. (2024). Artificial intelligence and the transformation of higher education institutions. *Sustainability*, 16(14), 6118[.](https://doi.org/10.3390/su16146118) <https://doi.org/10.3390/su16146118>
  2. [38]. Association of American Medical Colleges. (2025). Responsible use of AI in and for medical education. Retrieved from [https://www.aamc.org/about-us/mission-](https://www.aamc.org/about-us/mission-areas/medical-education/principles-ai-use) [areas/medical-education/principles-ai-use](https://www.aamc.org/about-us/mission-areas/medical-education/principles-ai-use)
  3. [39]. American Medical Association. (2025). AI in medical education. Retrieved from <https://www.ama-assn.org/education/changemeded-initiative/ai-medical-education>
  4. [40]. Mir, M. M., Mir, G. M., Raina, N. T., Mir, S. M., Mir, S. M., & Miskeen, E. (2023).

Application of artificial intelligence in medical education: current scenario and future perspectives. *Journal of Advances in Medical Education & Professionalism*, 11(3), 133-

140. <https://doi.org/10.30476/JAMP.2023.98655.1803>

* 1. [41]. Hamilton, A. (2024). Artificial intelligence and healthcare simulation: the shifting landscape of medical education. *Cureus*, 16(6), e59747. <https://doi.org/10.7759/cureus.59747>
  2. [42]. Rodman, A; James, CA. Effective Engagement With AI Is the Only Path Forward for Clinician-Educators. Academic Medicine 100(9S):p S46-S48, September 2025. | DOI: 10.1097/ACM.0000000000006102
  3. [43]. Turner, L; Zhou, C; Burk-Rafel, J. It Takes More Than Enthusiasm: The Missing Infrastructure to Unlock AI’s Potential in Medical Education. Academic Medicine 100(9S):p S34-S38, September 2025. | DOI: 10.1097/ACM.0000000000006104
  4. [44]. Gehrman E (2024). How Generative AI Is Transforming Medical Education. Harvard Medicine. [https://magazine.hms.harvard.edu/articles/how-generative-ai-](https://magazine.hms.harvard.edu/articles/how-generative-ai-transforming-medical-education) [transforming-medical-education](https://magazine.hms.harvard.edu/articles/how-generative-ai-transforming-medical-education)
  5. [45]. Narayanan, S., Ramakrishnan, R., Durairaj, E., & Das, A. (2023). Artificial intelligence revolutionizing the field of medical education. *Cureus*, 15(11), e49604[.](https://doi.org/10.7759/cureus.49604) <https://doi.org/10.7759/cureus.49604>
  6. [46]. Rojas, M. P., & Chiappe, A. (2024). Artificial intelligence and digital ecosystems in education: A review. *Technology, Knowledge and Learning*, 29(6), 2153-2170. <https://doi.org/10.1007/s10758-024-09732-7>
  7. [47]. Chan, C.K.Y. A comprehensive AI policy education framework for university teaching and learning. Int J Educ Technol High Educ 20, 38 (2023). <https://doi.org/10.1186/s41239-023-00408-3>
  8. [48]. U.S. Department of Education. (2023). *Artificial intelligence and the future of teaching and learning: Insights and recommendations*. Office of Educational Technology. Retrieved from [https://www.ed.gov/sites/ed/files/documents/ai-report/ai-](https://www.ed.gov/sites/ed/files/documents/ai-report/ai-report.pdf) [report.pdf](https://www.ed.gov/sites/ed/files/documents/ai-report/ai-report.pdf)
  9. [49]. OECD. (2023). *OECD digital education outlook 2023: Towards a digital transformation of education*. OECD Publishing[.](https://doi.org/10.1787/c74f03de-en) <https://doi.org/10.1787/c74f03de-en>
  10. [50]. Lamalif, L., Machkour, M., Faris, S., & Mansouri, K. (2024). Toward a new model for the successful implementation of information and communication technologies in education. *Frontiers in Education*, 9, 1470799. <https://doi.org/10.3389/feduc.2024.1470799>
  11. [51]. Gillani, N., Eynon, R., Dillenbourg, P., & Chatterjee, R. (2023). Artificial intelligence in intelligent tutoring systems toward sustainable education: a systematic review. *Smart Learning Environments*, 10(1), 41. [https://doi.org/10.1186/s40561-023-](https://doi.org/10.1186/s40561-023-00260-y) [00260-y](https://doi.org/10.1186/s40561-023-00260-y)
  12. [52]. Asicedtech (2024). Asicedtech- Adaptation- Standardisation - Integration- Compliance Framework online platform [https://asicedtech.com](https://asicedtech.com/)

## Appendix 1: ASIC Framework Instruments Adapted for AI use in Medical and Higher Education (Asicedtech, 2024)

**Adaptation**

* + - **Consideration**: The use of AI is indicated in the curriculum/syllabus (i.e. there is a specified time/period/duration for AI-supported activities).
      * Yes ☐ No
    - **Consideration**: AI tools are deployed to achieve stated learning objectives (i.e. there is a clear objective statement that aligns with AI use in teaching or training).
      * Yes ☐ No
    - **Consideration**: The impact of AI on learning outcomes is measured with formative/summative assessments (i.e. AI-enhanced learning outcomes are identified and assessed).
      * Yes ☐ No

## Standardisation

* + - **Consideration**: Time allocation for the use of AI tools is indicated in the curriculum/syllabus (i.e. there is a specific time/period allocated for AI-supported learning).
      * Yes ☐ No
    - **Consideration**: The method of AI use is pre-determined and a protocol/guide is prepared (i.e. a standard operating procedure or instructional design plan exists for AI use).
      * Yes ☐ No
    - **Consideration**: AI-supported activities are aligned with specific objectives that are also measured or assessed (i.e. objectives are defined and linked to assessment criteria).
      * Yes ☐ No

## Integration

* + - **Consideration**: Specific competencies to be achieved with AI are identified in the curriculum/syllabus (i.e. AI-supported sessions contribute directly to programme competencies).
      * Yes ☐ No
    - **Consideration**: The use of AI tools aligns with established pedagogy and learning theories (i.e. AI deployment follows pedagogical principles and lesson planning).
      * Yes ☐ No
    - **Consideration**: Assessment of AI-supported learning contributes to final measures of training impact (e.g. AI-informed assessments or analytics are factored into grading or evaluations).
      * Yes ☐ No

## Compliance

* + - **Consideration**: The use of AI aligns clearly with the curriculum philosophy and/or programme objectives (i.e. there is evidence of institutional compliance).
      * Yes ☐ No
    - **Consideration**: AI adoption is consistent with institutional or programme philosophies on pedagogy and teaching methods (i.e. evidence of policy and standard-practice compliance exists).
      * Yes ☐ No
    - **Consideration**: The evaluation of AI’s impact on learning aligns with institutional and/or regulatory requirements (i.e. ethical, accreditation, and cultural compliance are demonstrated).
      * Yes ☐ No

Source: <https://asicedtech.com/> [52]

Acknowledgment

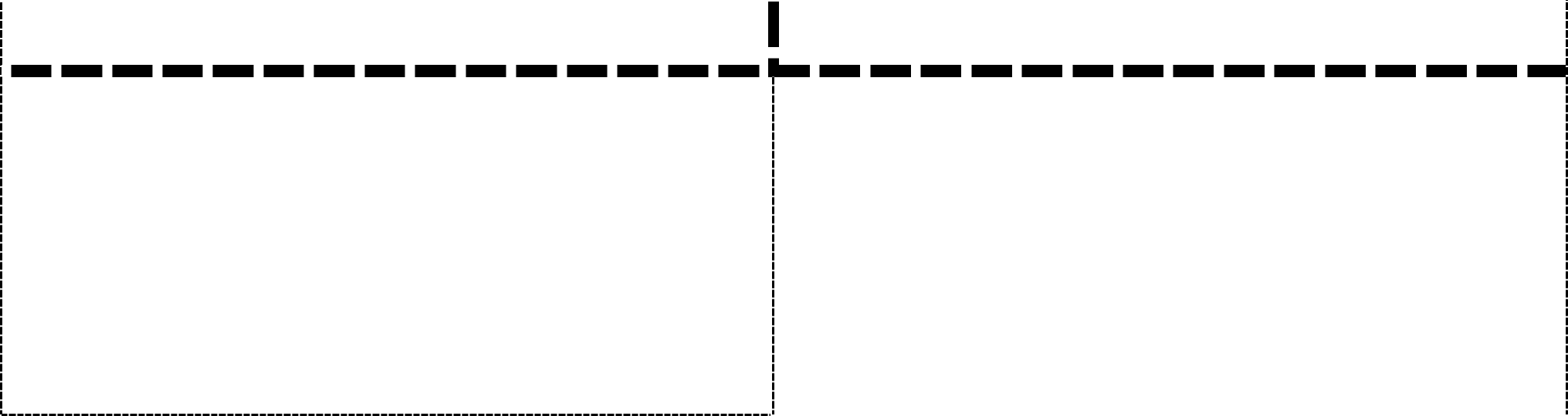
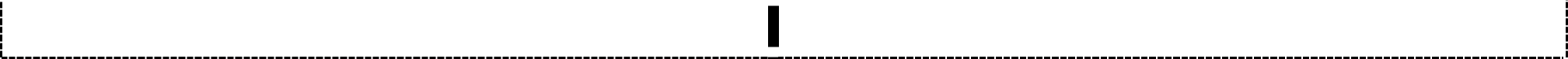
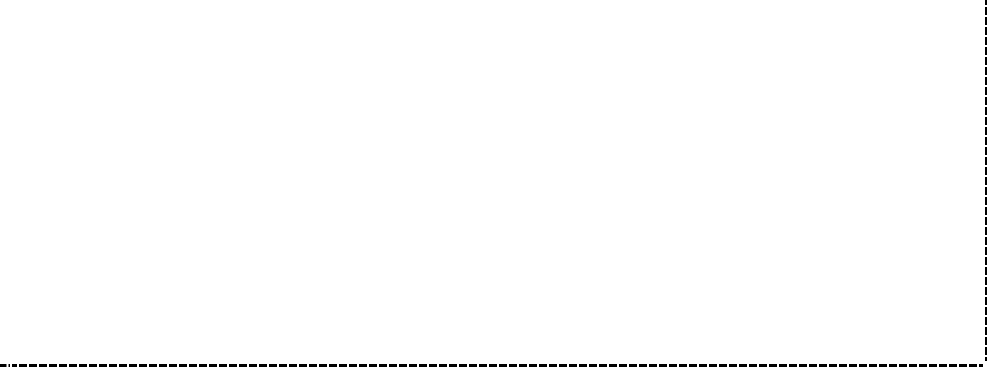
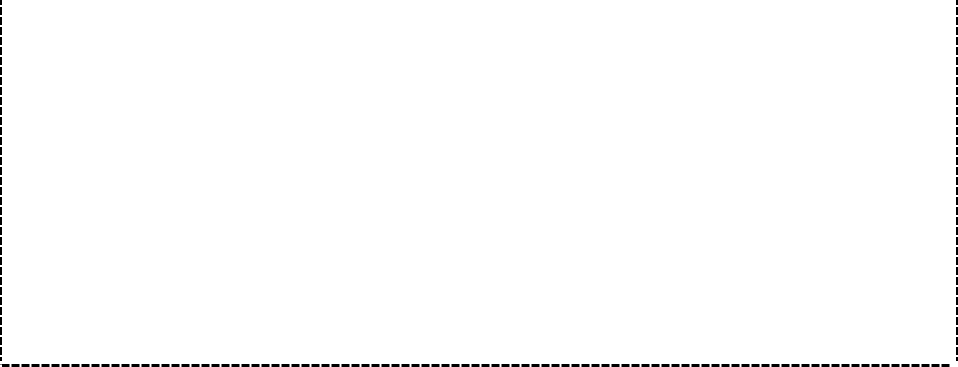
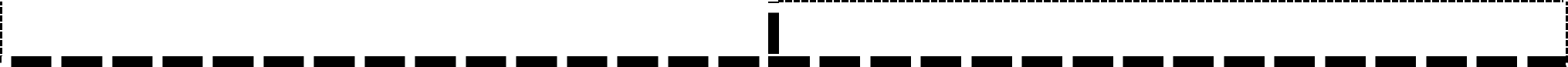
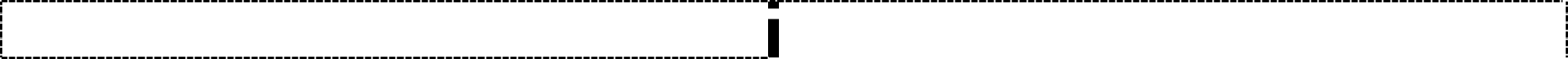
**Harvard Macy Course mates:** This adaptation of the ASIC Framework to support AI deployment in medical and higher education was a major component of the Harvard Macy Course for Educators, Year 2024 - 2025. Course mates contributed to the idea formulation through constructive critique, following presentation and continuous refinement of the idea until the final translation of the original ASIC Framework was adapted to AI deployment following a methodical process similar to a Delphi approach. Special thanks to the course faculty as well.

**PCOM**: Institutional support from the Philadelphia College of Osteopathic Medicine (PCOM) helped attend the HMI course during which the refinements and adaptation of the ASIC Framework to support AI deployment activities took place.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **ASIC Framework Results Interpretation Rubric** | | | | | | |
|  | **Poor**  **<60** | **Good 61- 70** | **Very Good 71-80** | **Excellent 81-90** | **Outstanding 91-100** | **General comment** |
| **Adaptation** | Does not sufficiently satisfy at least 1 adaptation- related component of combined CPA requirements | Partially satisfies at least 1 adaptation- related component of combined CPA requirements | Sufficiently satisfies at least 1 adaptation- related component of combined CPA requirements | Sufficiently satisfies at least 2 adaptation- related components of combined CPA requirements | Sufficiently satisfies 3 or more adaptation- related components of combined CPA requirements | A less than 2/3 score under **Adaptation** requires consideration to sufficiently meet the > 2/3 requirement. |
| **Standardisation** | Does not sufficiently satisfy at least 1 standardisation  -related - component of combined CPA requirements | Partially satisfies at least 1  standardisation - related -component of combined CPA requirements | Sufficiently satisfies at least 1 standardisation - related -component of combined CPA requirements | Sufficiently satisfies at least 2 standardisation - related -components of combined CPA requirements | Sufficiently satisfies 3 or more standardisation- related components of combined CPA requirements | A less than 2/3 score under **Standardisation** requires consideration to sufficiently meet the > 2/3 requirement. |
| **Integration** | Does not sufficiently satisfy at least 1 integration- related component of combined CPA requirements | Partially satisfies at least 1 integration- related component of combined CPA requirements | Sufficiently satisfies at least 1 integration-related component of combined CPA requirements | Sufficiently satisfies at least 2 integration  -related components of combined CPA requirements | Sufficiently satisfies 3 or more integration- related components of combined CPA requirements | A less than 2/3 score under **Integration** requires consideration to sufficiently meet the > 2/3 requirement. |
| **Compliance** | Does not sufficiently satisfy at least 1 compliance -  related -  component of combined CPA requirements | Partially satisfies at least 1 compliance- related component of combined CPA requirements | Sufficiently satisfies at least 1 compliance-related component of combined CPA requirements | Sufficiently satisfies at least 2 compliance  -related - components of combined CPA requirements | Sufficiently satisfies 3 or more compliance- related components of combined CPA requirements | A less than 2/3 score under **Compliance** requires consideration to sufficiently meet the > 2/3 requirement. |
| **Total:** | Consider ALL ASIC tenets to meet minimum requirements. | Consider ALL ASIC tenets to improve on EdTech/innovations’ performance requirements. | Consider ASIC tenets with low ASIC values to improve on EdTech/innovations’ performance requirements. | Consolidate ASIC tenets values by improving performance in concerned categories to fully optimise EdTech/innovations’ performance. | Sustain ASIC tenets values and translate value to the actual context of use and practice for optimal EdTech/innovatio ns’ performance. | **ASIC** |
|  | | | | | | |
| **Keys:**  **CPA Requirements: C-** Curriculum; **P-** Pedagogy; **A-** Assessment  **ASIC Tenets: A**- Adaptation; **S**- Standardisation; **I**- Integration; **C**- Compliance  ©ASIC EdTech 2024 | | | | | | |



**ASIC Tenets and Meaning- An Overview**



**A**

**Adaptation**

Adaptation implies that innovations and educational technologies or EdTech should be suitably adapted to the learning

ecosystem, programme design and institutional system, for optimal performance and best outcomes.

**S**

**Standardisation**

Standardisation involves determining clearly the purpose that innovations and technologies serve, the objectives they meet; and supporting their uses with evidence for best and standard practices. It also involves the use of innovations and EdTech in alignment with sound educational and learning principles.

Integration involves creating a place for the use of educational innovations and technology within the immediate teaching or training ecosystem; and aligning its use with other components of the educational system for optimal performance. Key considerations include system thinking and synergy.

Compliance

emphasises alignment with

institutional policies, regulations and practices as well as relevant regulatory requirements [if applicable]. Evidence of compliance with

institutional

standards,

programme

requirements and regulations of relevant bodies should be addressed.

TOTAL SCORE = ASIC VALUE

**C**

**Compliance**

**I**

**Integration**

©ASIC EdTech 2024

**Open Access Technical Report**

**Review began** 12/24/2024 **Review ended** 01/07/2025 **Published** 01/09/2025

**© Copyright** 2025

Owolabi. This is an open access article distributed under the terms of the Creative Commons Attribution License CC-BY 4.0., which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

**DOI:** 10.7759/cureus.77191

#### Digitized ASIC (Adaptation, Standardization, Integration, and Compliance) Framework: An Innovation for Optimizing Technologies and Innovations for Medical and Higher Education

[Joshua Owolabi](https://www.cureus.com/users/492388-joshua-owolabi) 1

1. Department of Biomedical Sciences, Philadelphia College of Osteopathic Medicine, Moultrie, USA

**Corresponding author:** Joshua Owolabi, [joshuaow@pcom.edu](mailto:joshuaow@pcom.edu)

Abstract

This article serves several specific purposes: Presenting transferable information on transforming innovative ideas into educational products with practical applications; showcasing a digitized version of a leading innovation aimed at optimizing technologies and innovations in medical education, health professions education, and higher education; advancing an evidence-based approach to integrating innovations into educational ecosystems and promoting education through innovations and technologies. A 10-step approach to developing the ASIC framework (ASIC stands for Adaptation, Standardization, Integration, and Compliance) is presented, with explanations and illustrations of the processes and activities involved.

Empirical evidence and sound principles are provided in support of activities to assure the validity and reliability of methods or procedures. The product of this innovative process is presented and described for the benefit of educators, academic leaders, and industry stakeholders on evidence-based practical approaches to deploying technologies for educational purposes to benefit learners or teachers, and the general society. The ASIC framework's four tenets, which include Adaptation, Standardization, Integration, and Compliance, are clearly defined. Evidence is presented to support ASIC tenets’ roles in deploying educational technologies and innovations, as well as in transformation agendas involving leading changes with innovation. Possible applications of this successful approach to educational change agenda and roles are also presented. Adequate reference is made to a need to premise interventions on relevant theories and principles including the adult learning theory, cognitive load theory, Bloom’s taxonomy, and connectivism. The IDEO model for leading change with innovation is also highlighted. This article could help educators, innovators, and other stakeholders by providing evidence on methodical approaches to developing and deploying useful innovations.

**Categories:** Medical Education, Medical Simulation, Healthcare Technology

**Keywords:** adaptation, artificial intelligence (ai), asic, compliance, framework, higher education, innovations, integration, medical education, standardization

Introduction

Educational technologies (EdTech) and innovations have become increasingly integral to other education in general, and especially for medical education and health professional education. This is largely a reflection of general advancements in technologies, innovations, and ways of life that have largely been based on technology. It is also a reflection of the transitions from the industrial age to the information age and the emphasis on the use of cutting- or bleeding-edge approaches to driving changes and creating solutions which in turn is largely technology-dependent. More specifically, there are numerous arguments supported by abundant evidence on the importance of technologies and innovations in support of medical education, medical practice, and health professions. In a world, that is being increasingly tech-driven, the culture of technology has significantly permeated medical, professional, and higher education. In fact, imbuing a tech culture into medical training and practice has arguably become a major aspect of emphasis toward training workers and professionals for the current places of work and is very important to meet the needs of the future demands in workplaces. Graduates and professionals without technological skills would not only have lacked vital skills but would also be alien to the emerging culture of work. People’s acceptance or aversions to technology could be complicated but are not impossible to explain. For example, the technology acceptance model (TAM) posits that users are motivated to use technology by three factors, namely, perceived usefulness, perceived ease of use, and attitude toward use [1-3].

There is evidence that technology is increasingly becoming integral to medical education and health service delivery [4-6]. This is true at the discipline level, such as in anatomy [7] and for medical education in general [8]. The COVID-19 pandemic highlighted the significant value of EdTech, digital innovation, and online learning in supporting and sustaining both medical education and healthcare delivery. This successful adaptation served as a crucial eye-opener, demonstrating the essential role of digital resources in advancing medical and health education while enhancing healthcare delivery systems [9-16].

**How to cite this article**

Owolabi J (January 09, 2025) Digitized ASIC (Adaptation, Standardization, Integration, and Compliance) Framework: An Innovation for Optimizing Technologies and Innovations for Medical and Higher Education. Cureus 17(1): e77191. DOI 10.7759/cureus.77191

Having established the place of innovation and EdTech in today's educational ecosystem, it is important to further highlight the place of technologies and innovations and their continuous deployment for educational purposes. One thing is clear, technology influences not just the use of technologies for educational activities but also the established methods, traditional practices, and, consequently, the culture of education and practice. In other words, technology used for educational purposes could influence the knowledge, skills, and attitudes of not just the learners and trainees but also the educators and trainers as

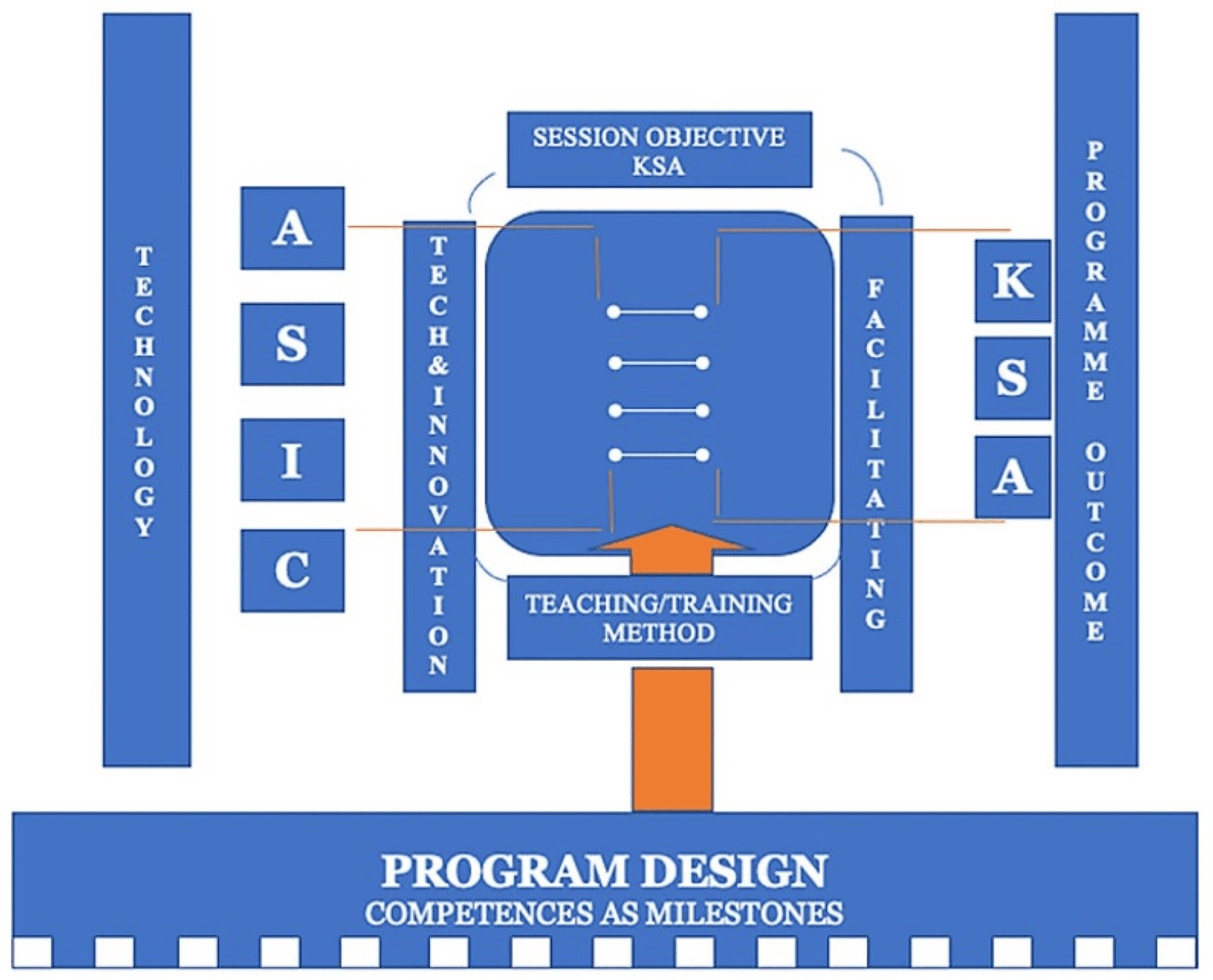
well. This last statement explains why the use of technology would require critical considerations, references to empirical evidence, and adherence to guiding principles and relevant theories. Poor consideration for standard practices, pedagogical principles, and relevant learning theories has resulted in observable heterogeneities in methods of EdTech use and the impacts they produce on learners. This needs to be addressed. It is in line with these realities that the ASIC framework for guiding the use of EdTech and innovation for medical education and its operational frameworks were developed and published [17-19].

This work, therefore, hypothesizes that heterogeneity in types and uses of innovations and technologies would limit their validity and reliability to achieve educational outcomes or competencies with optimal outcomes except that they are used based on guiding principles that are premised on sound educational theories as well as empirical; the evidence is used to form the basis of judgment, and strategies for use and their pedagogical approaches. Furthermore, this work proposes that to optimize the use of an innovation or EdTech to support higher education or medical education, there are three key areas of consideration which include curriculum, pedagogy, and assessment.

Technical Report

**Method**

This section presents a 10-step approach to digitalizing the ASIC framework, starting with defining a clear problem in need of a solution to creating a product with proof of concepts for practical applications and navigating through technical and legal issues. While it is important to state that these steps were not necessarily followed strictly sequentially, it is important to note that the 10 steps have been clearly highlighted in a way that they could form a practical guide for an educator or an innovator seeking information on steps to a methodical approach or producing an educational innovation. They also serve to present evidence that the ASIC framework has been developed with adequate considerations for the creative flow of thought, application of sound medical theories and principles, and project management knowledge and skills (Figure *1*). The 10-step approach is highlighted as follows:



**FIGURE 1: ASIC framework adapted from the original work on ASIC.**

An illustration showing a relationship between the use of technologies and innovations for educational purposes in a specified context such as the classroom or simulation facility in connection with the outcomes in the domains of knowledge skills and attitude. It also represents the functional and operational relationship between technologies/innovations, teaching or training and program outcomes in relation to competencies as milestones based on program design [17,18].

ASIC: Adaptation, Standardization, Integration, and Compliance; K: Knowledge; S: Skill; A: Attitude.

*Defining a Problem in Need of Intervention*

The problem statement for the current work could be stated as follows: Heterogeneities in EdTech and innovation use and impact are resultant of a lack of established standard practices and poor adherence to pedogeological practices and relevant learning theories while deploying educational technology and innovations. The initial idea to have a framework, standard tool, guiding theory, or a set of principles for optimizing the use of innovations and technologies for medical education was identified through experiences, multi-institutional, multinational, and action project activities [20-22]. A critical appraisal of EdTech use in a medical school that was highly innovative and tech-driven yielded a number of considerations that were further crystallized into key tenets. A reflective practice and critical analysis of how the efforts succeeded helped to analyze the purpose of the key tenets. Further critical thinking and analysis helped to design a hypothetical educational ecosystem and connect the tenets with actual elements of the ecosystem, through an iterative process that helped design a sample reference framework model with working principles that could be applied to diverse educational systems. The four tenets include Adaptation, Standardization, Integration, and Compliance. From these, the acronym ASIC was made, and the emergent framework was named the ASIC framework for optimizing EdTech and educational innovations.

Following the successful publication of the original idea as a scholarly article with quality peer review, a tool for operationalizing the framework so that educators and academic leaders can effectively apply the principles of the ASIC framework was developed and published as the ASIC matrix. Continual use of the original matrix provided further insights into a need to further simplify the application of the ASIC principles for medical educators whose interest revolves around certain core aspects of medical or higher education which were defined to include Curriculum (C), pedagogy (P), and assessment (A) in line with the identified pillars of medical education which are relevant to teaching- and training-related practices.

Consequently, the ASIC framework operational matrix that addressed innovation and EdTech’s optimization with emphasis on curriculum, pedagogy, and assessment was designed and published as the ASIC framework CPA operational matrix. This ASIC framework CPA operational matrix was successfully digitized for ease of access, use, and appraisal of educational innovations and technologies. It also accrues features that validate the use of the digital tool.

*Establishing a Sound Theoretically Correct and Pedagogically Sound Model*

It was important to ensure that the model aligned with relevant learning theories and pedagogical principles for teaching. Here are selected specific instances (see Table *1*).

**TABLE 1: Steps for establishing a sound theoretically correct and pedagogically sound model.**

ASIC: Adaptation, Standardization, Integration, and Compliance; EdTech: educational technologies.

|  |  |  |
| --- | --- | --- |
|  | **Key considerations** | **Additional information** |
| a | Adult learning theory [23,24] | ASIC was designed with the premise that the beneficiaries of EdTech use for medical and higher education are adults; it also considers a learner-centered approach. |
| b | Cognitive load theory [25,26] | ASIC design has a premise that EdTech use should minimize extraneous load and optimize intrinsic load while managing germane load effectively. |
| c | Miller’s pyramid [27,28] | ASIC framework requires that the learning outcomes should be clearly defined and measurable in line with the EdTech and innovation[s] used. |
| d | Kolb’s learning cycle [29,30] | The use of an EdTech is aligned with Kolb’s cycle such that it could contribute to the process of achieving a holistic learning experience, e.g. an educator could decide whether an EdTech served the purpose of experimentation or conceptualization. |
| e | Bloom’s pyramid [31,32] | There is a premise that the use of an EdTech or innovations should be aligned with an identified level of Bloom’s pyramid. For example, an educator should determine whether a learner who uses an interactive 3D anatomy digital atlas needs to identify the already dissected anatomic structures or to explore, self-dissect, identify, and describe. |
| Visual, auditory,  Considerations for multiple modality nature of educational resources: There were considerations for the use  reading/textual, and  f of resources that provide knowledge (cognitive), or that help to impart skills (psychomotor) or attitude kinesthetic (VARK)  (affective) in the forms of visual, auditory, reading/textual, and kinesthetic (VARK) modalities [33,34].  modalities [33,34] | | |

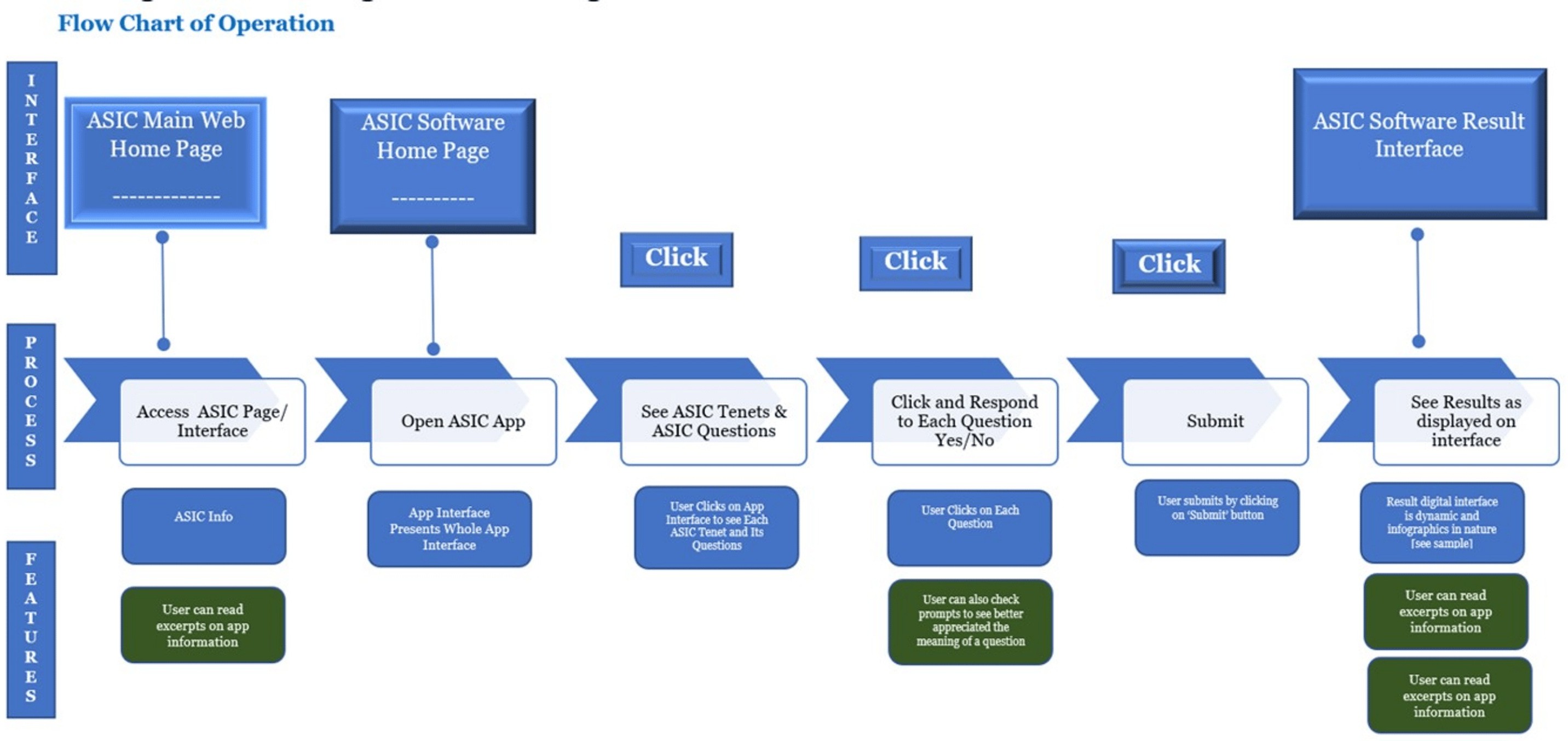
*Generating Practical Evidence From Practice*

After putting together ASIC as a framework, evidence was obtained from actual practice in different contexts of subjects, institutions, and students. Publishing the framework first, the first operational matrix and the alternative operational matrix in peer-reviewed articles provided major opportunities for critique from educators and academic leaders. Teaching and communicating the ASIC concepts in professional meetings, institutional training-the-trainers programs, and other fora provided quality feedback for improvement.

There was also published evidence of adoption in other climes.

*Designing an Algorithm Flow*

An algorithm flow for the digital operation of ASIC was developed (Figure *2*). The algorithm was communicated to a team of assembled designers and programmers; the initial algorithm flow was tested and iteratively remodified until a suitable flow was obtained. The adopted model was the basis for the digitalized version of the ASIC operational matrix.



**FIGURE 2: Summary of algorithm flow of actions and functions for the start to submission.**

The process includes the following: Access Interface -> Open App -> See ASIC Tenets & ASIC Questions -> Click and Respond to Each Question Yes/No --> Submit -> See Results as displayed on the interface.

ASIC: Adaptation, Standardization, Integration, and Compliance.

*Writing Codes and Creating a Suitable Platform*

First, a suitable algorithm was designed, then, clear specifications for cloud and web-based support platforms were defined. Key considerations included operational effectiveness, functionality, user interface accessibility, security protocols for both users and applications, data protection measures, interactivity, and access management. Following a proper understanding of the major considerations, the codes for the digital framework were written. The process was iterative as the developer team met iteratively with the ASIC inventor to test the product at every stage. A workflow for a test-analyze-validate-and-progress model was adopted.

*Producing a Proof of Concept*

Following the collection of coding and testing, ASIC was made available to the developer and the expert teams who consistently interacted with the platform for over three months. During this period of interaction, bugs were identified and fixed, and web esthetics and interfacility were considered and addressed as well. Several modifications were made to ensure an optimally technically efficient ASIC product with quality attributes for access, security, reliability, interactivity, and user-friendliness in terms of attractive interface esthetics.

*Quality Assurance and Validation*

For the purpose of quality assurance: The ASIC inventor ran multiple tests to test operations and output and to check the product’s efficiency. An expert and senior educator was consulted for assessment, and also ASIC was made available to the public for use. Useful feedback was collected and applied.

*Reflective Practice as Tool for Continuous Refining of Idea*

Right from the initial release of the ASIC digital product, there has been regular analysis of feedback; much more importantly, a reflective practice based on experience, reflection, and purposeful action (ERA) has been continually applied to ASIC to optimize the technical capacities of ASIC but also very importantly, the ease of use and applications to enhance user’s productivity and efficiency in relevant contexts. This is an ever-continuous process.

*Product Improvement Through Educational Research*

There is a solid plan in place for product improvement through educational research. ASIC is available for educational research purposes and concession is made to researchers to afford them the opportunity to conduct research on product sustainability and impacts. Also, there is a standard ASIC Research Instrument that can be used by researchers to conduct research in their immediate educational context which can be published eventually. On the other hand, researchers can use the instrument to collect data as members of a global ASIC EdTech consortium toward advancing medical and higher education. This questionnaire

instrument is made available at no cost to researchers.

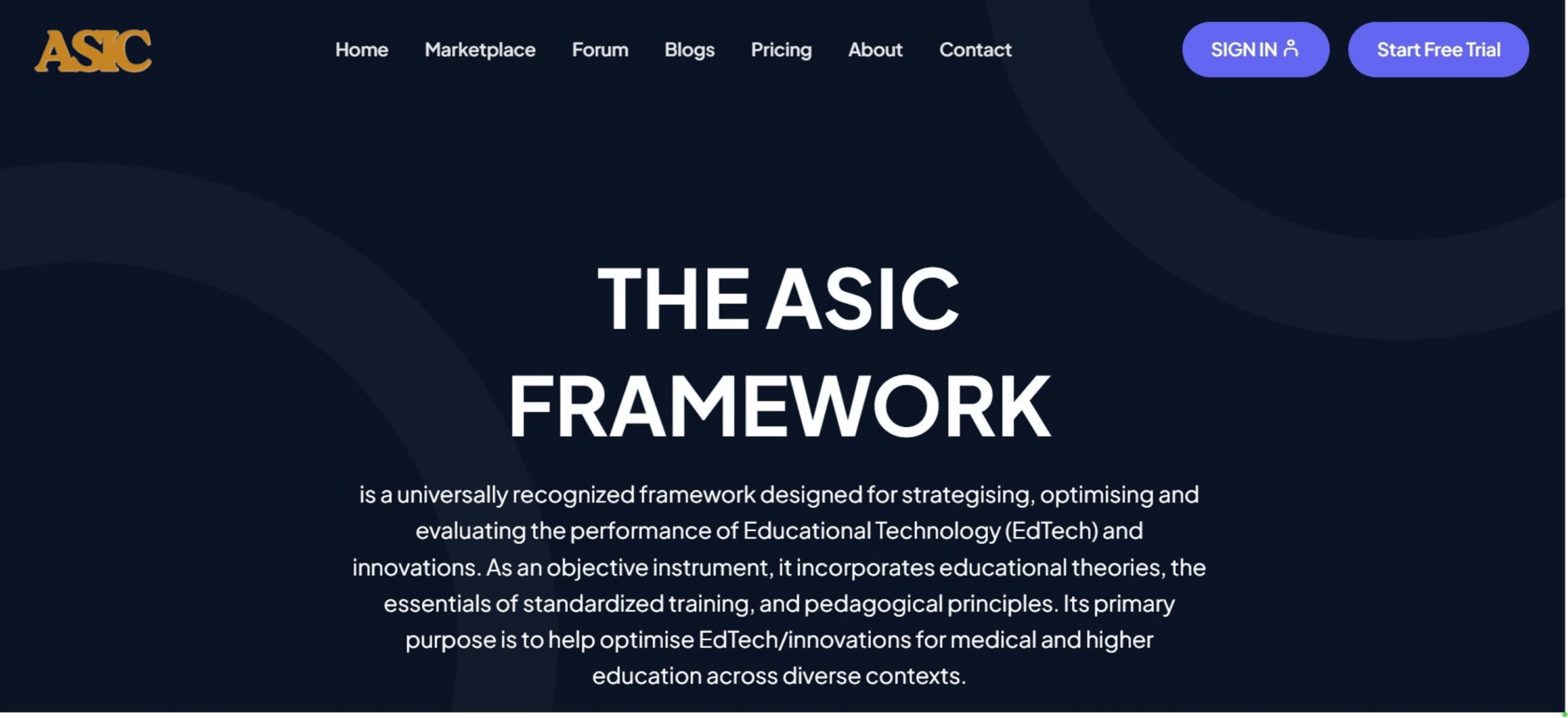
*Legal and Technical Conditions: Continuous Evaluation of Product*

The ASIC (EdTech) operational matrix is published and the inventor and author have copyright to its original forms in line with the guidelines and policies of the journals in which it was originally published. The digitalized version, being a digital product, is currently being processed for a patent right. This ensures intellectual protection and protects from adulteration that could be scientifically and technically counter- productive to the optimization of the product. It also serves as a good example for educators who are equally innovators on a need to optimize their original innovations or inventions and put in place appropriate legal and intellectual protections.

**Result**

*The Digital ASIC Framework*

The digital ASIC framework has all the elements of the originally developed and published ASIC framework, which emphasizes Adaptation, Standardization, Integration, and Compliance in three key areas, namely, curriculum, pedagogy, and assessment. While the ASIC tenets emphasize the key areas of consideration to address when deploying EdTech and innovations, the CPA emphasizes the core domains that require attention. The digital framework and its operational matrix allow the ASIC tenets to address the CPA domains in line with each tenet. For example, the operational matrix addresses the place of adaptation in the place of curriculum, pedagogy as well as assessment. The digital framework is now available as an App that requires the user to answer 12 questions in all with three CPA (curriculum, pedagogy, and assessment) questions under each ASIC tenet (Figure *3*) [35].



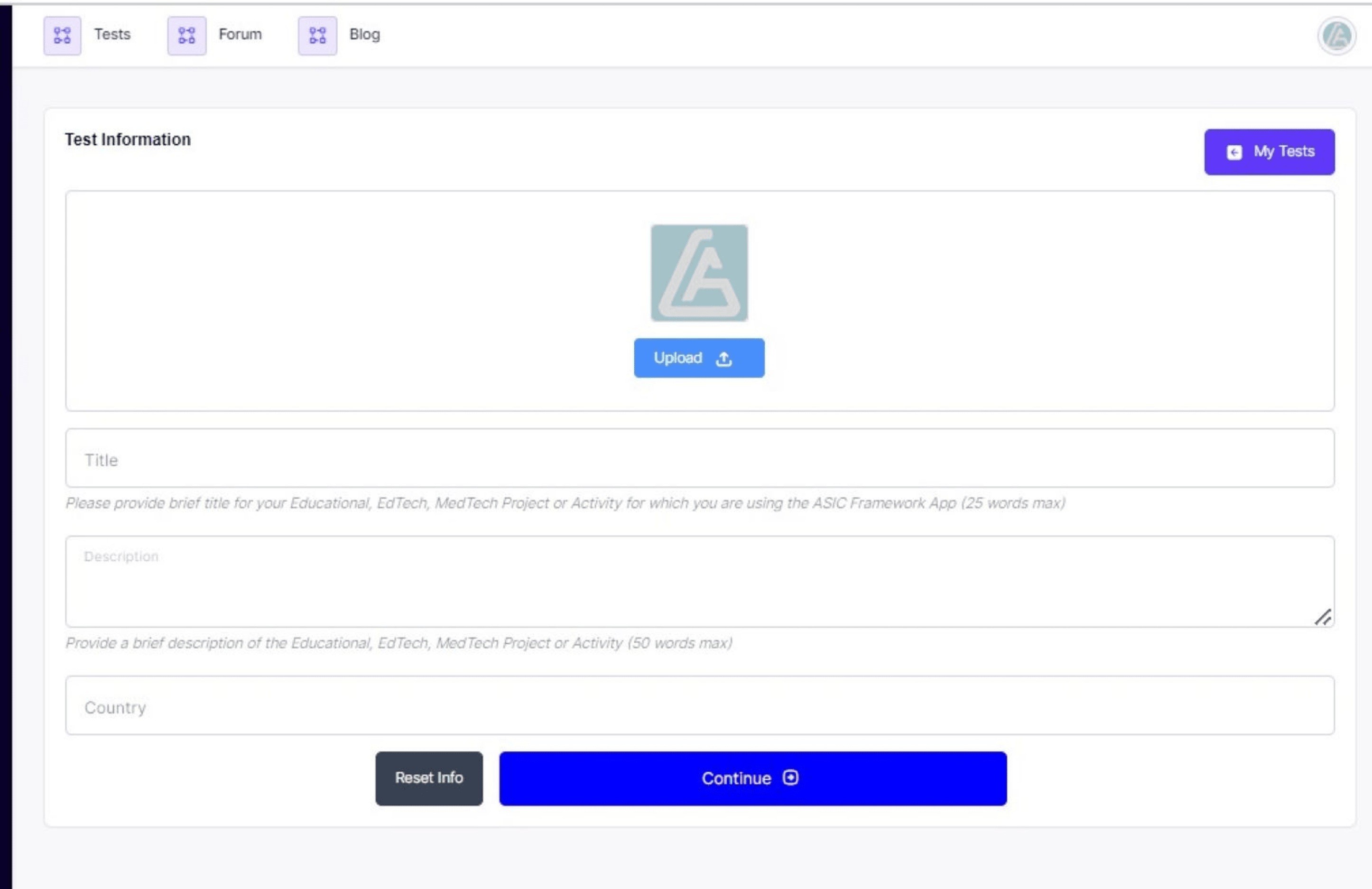
**FIGURE 3: ASIC webpage interface,** [**https://asicedtech.com/**](https://asicedtech.com/)**.**

Clicking the named buttons and icons takes the user to each feature of the ASIC EdTech framework features. The sign-in link takes the user to the dashboard that has the ASIC EdTech app with a set of instructions to follow.

ASIC: Adaptation, Standardization, Integration, and Compliance; EdTech: educational technologies.

*Digital ASIC Framework: A Description*

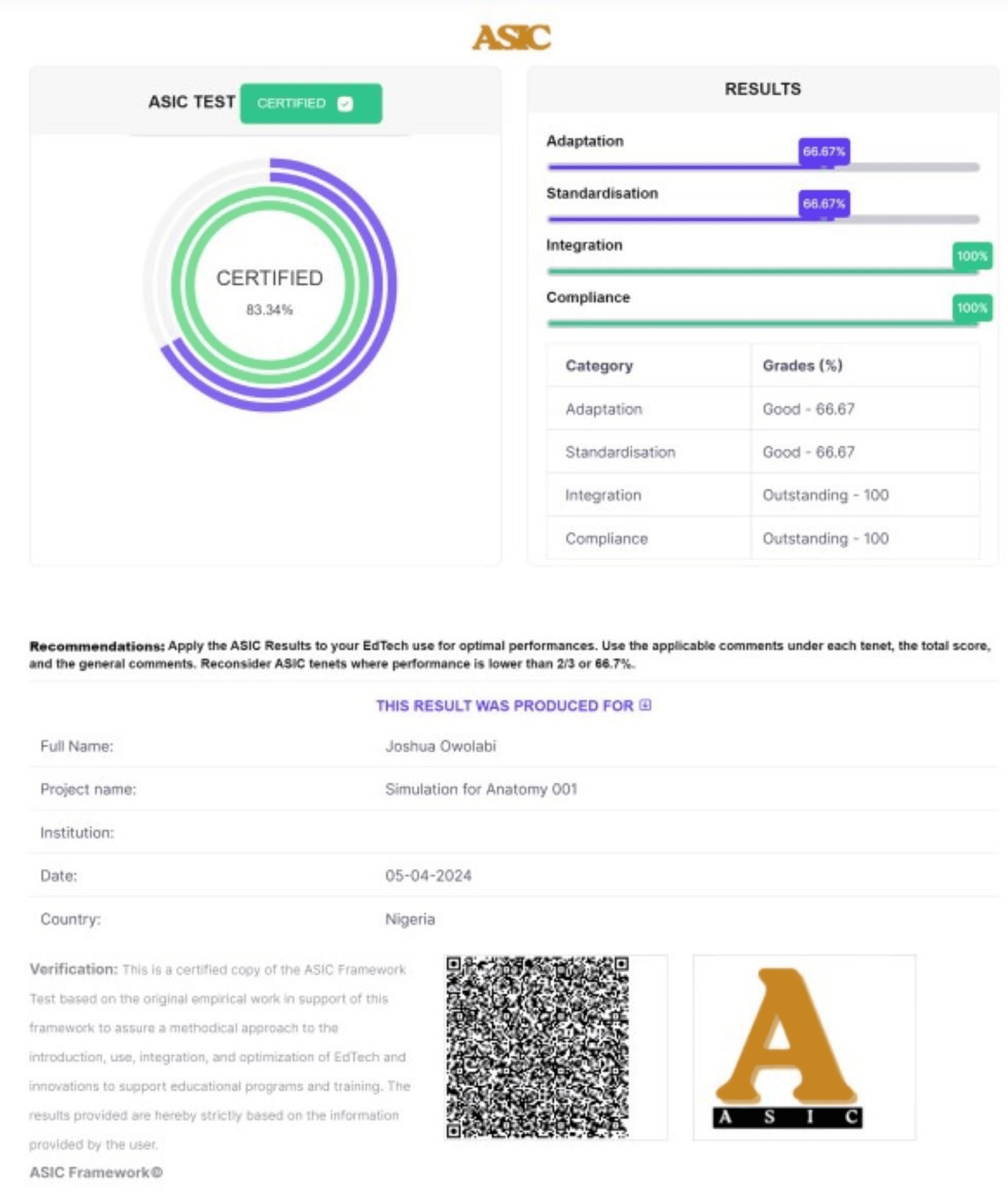
The digital ASIC framework is accessed through the ASIC EdTech webpage or as an Android or IOS App (Figure *3*). Once accessed or installed in the latter instance, the ASIC Digital interface requires the user to enter specific information about the EdTech of interest (Figure *4*). A logo can also be provided. The interface thereafter requires the user to answer Yes/No to three CPA (curriculum, pedagogy, and assessment) questions under each ASIC (Adaptation, Standardization, Integration, and Compliance) tenet. Upon completion and submission, the result is generated with unique features for identity including the ASIC scores and the performance indicators both in numerical values as percentages and in graphical format. The total sum of impact value is also provided. The result is released with a barcode feature that can always be used to access the results and verify their authenticity (Figure *5*). The result is also archived under the user's account and it is perpetually accessible. When downloading the unique result, the ASIC interpretation rubric is also downloadable for reference.



**FIGURE 4: ASIC EdTech test interface.**

This interface allows the user to enter basic information about the technology or information of interest. This information is saved and used to identify the results of the test subsequently.

ASIC: Adaptation, Standardization, Integration, and Compliance; EdTech: educational technologies.



**FIGURE 5: Digital results features.**

The result's interface has a dynamic interface with illustrations with a pictogram of test-indicated performances and a barcode.

*Explaining ASIC Working Principles*

ASIC framework has four tenets namely Adaptation, Standardization, Integration, and Compliance. In terms of working principles, the ASIC operational matrix considers the application of the four tenets to three core areas of an educational experience, namely curriculum, pedagogy, and assessment. This is of key significance as the inability to operationalize the ASIC framework would either create ambiguity and subjectivity or make it impractical for accurate application. Application of ASIC to curriculum helps to address the validity and reliability of the use of EdTech and innovation for an educational experience. It also helps to determine whether the EdTech and innovation as used could provide an appropriate and adequate educational experience based on curricular requirements and whether a plan for consistent and accurate repeatability has been considered. Pedagogy also helps with the validity of an educational experience by assuring educational methods in line with relevant theories and principles such as adult learning

theories. Assessment helps to measure the impact value of an EdTech/innovation on the learning experience as a measure of performance. The place of the CPA areas of ASIC applications can be highlighted as follows (see Table *2*).

|  |  |  |
| --- | --- | --- |
|  | **CPA**  **domains** | **ASIC applications** |
| a | Curriculum | This considers the appropriateness of an EdTech/innovation to accomplish learning outcomes and ultimately program competencies-based program design and specific indicative content in the curriculum. |
| b | Pedagogy | This considers the educational value of the EdTech/innovation based on the applicable learning theories and pedagogical principles. It considers whether an EdTech/innovation can adequately help to achieve the objectives or outcomes of learning sessions in one or more of the cognitive, psychomotor, and affected domains. |
| c | Assessment | This considers whether the assessment exercises based on the use of an EdTech or innovation could meet assessment validity and reliability criteria in alignment with competencies that are required to be acquired ultimately. |

*Practical Use of ASIC Framework for Individuals, Groups, and Administrators*

**TABLE 2: ASIC applications to CPA.**

CPA: curriculum, pedagogy, and assessment; ASIC: Adaptation, Standardization, Integration, and Compliance; EdTech: educational technologies.

ASIC framework tool and its operational matrix can be used by individual educators, groups of educators such as those in a department or program faculty, or by administrators and organizational or institutional levels. Below are descriptions of specific contexts or settings and the basic steps included in using ASIC to assure innovation/EdTech optimization:

ASIC for individual use: When used by an individual educator, ASIC could help to make the choice of the most appropriate innovation or EdTech to acquire, how to systematically integrate the EdTech/innovation into a course or program, and how to optimize the use of the EdTech, then validly and reliably measure the impact through assessments of students and evaluation of the experience. Table *3* has the key considerations.

|  |  |  |
| --- | --- | --- |
|  | **Key considerations** | **Additional information** |
| 1. | Identify the innovation or EdTech of interest | a. This might be made through a needs assessment |
|  |  | b. It could also be a response to an identified problem that technology could address |
|  |  | c. Or a response to an institutional agenda to use technology or a trend in the educational and professional arena |
| 2. | Define clearly the context of the use | a. Determine how specifically the EdTech adds value to students’ educational experience in the knowledge, skill, and attitude domain |
|  |  | b. Define the pedagogical framework that would guide the use of Edtech/innovation. |
|  |  | c. Determine a practical approach to its integration into the structural and functional aspect of your educational practice or teaching by considering curricular schedules, physical or technical space, and virtual environments - whichever might be applicable. |
| 3. | Envision its prospects to add value to your overall educational ecosystem | a. Align the use of innovation/EdTech with curriculum requirements and reflect how its use to achieve these could be justified. |
| 4. | Apply ASIC and use the result for optimization | a. Answer each ASIC question. |
|  |  | b. Use the prompt in each case to guide proper reflection. |
|  |  | c. Document your supporting statements following reflections on each question. |
|  |  | d. Use the document with all supporting statements as the guiding template to assure adaptation, standardization, integration, and compliance. |
| 5. | Deploy, and measure performance by outcome, acceptability by feedback. | a. Keep to the set standard following the ASIC exercise in the previous step. |
|  |  | b. Document experience in relation to the standard under each tenet. |
|  |  | c. Use the experience versus pre-set standard to a reflective practice, to generate an action plan for sustainability and improvements. |
| 6. | Improve the approach to deployment and re-deploy | a. Evaluate EdTech performance following deployment, and apply valid evaluation results. |
| 7. Keep optimizing a. Apply evidence to advance practices and keep iterating. | | |

ASIC for group use: A group of faculty members such as a member of a department or faculty members in a program can collaboratively use ASIC to guide EdTech deployment, and measure impacts and plan further improvement. In this instance, each faculty member or stakeholder can complete the ASIC Instrument, then averages of responses are computed and the interpretations of the verdicts are based on the ASIC rubrics.

**TABLE 3: Key steps and considerations on how to use the ASIC framework by individuals.**

ASIC: Adaptation, Standardization, Integration, and Compliance; EdTech: educational technologies.

The alternative approach would be that the group of educators deliberate and arrive at a consensus on each ASIC Instrument item. Then, the consensus is interpreted using the rubric and this final outcome being a reflection of the collective verdict would guide decisions on EdTech use and optimization. The benefit of the latter approach is that the ASIC Instrument can be used iteratively. When an ASIC tenet scores zero, deliberations can help to reflect on the existing circumstances, and a decision can be made to restructure the same to favor a positive consideration such that the process helps to also determine the change that is required to favor the use of the EdTech/innovation of interest (see Table *4*).

|  |  |  |
| --- | --- | --- |
|  | **Key considerations** | **Additional information** |
| 1 | Define an area of educational experience to be enhanced using innovations/EdTech | a. Define the context of use properly. |
| 2 | Identify an EdTech/innovation to adopt | a. Determine the most appropriate EdTech or innovation, especially based on need, feasibility, and educational value. |
| 3 | Design the process of introduction into the ecosystem; consider the key 4Ps namely purpose, people, process, and product/outcome. | a. Purpose - the need to use the technology should be clearly justified. |
|  |  | b. People - the individuals that would be involved in the EdTech/innovation- enabled change and their roles should be clearly defined and assigned. |
|  |  | c. Process - the process of change, as a roadmap, should be presented. |
|  |  | d. Product/outcome - the envisioned outcome should be stated and well aligned with curricular indicative contents, program design, and professional competence to be acquired. |
| 4 | Apply ASIC tenets; obtain an initial result and use it to optimize deployment. | a. Answer ASIC questions, preferably as a group. |
|  |  | b. Apply prompts to clarify verdicts leading to the answer. |
|  |  | c. Generate a document of 1-3 key considerations on which a favorable answer to each tenet was premised. |
|  |  | d. Carefully curate the document (generated under 4c) into a document that informs the practice that would guide the institutional and professional use of EdTech and innovation. |
| 5 | Deploy, and measure performance by outcome, acceptability by feedback. | a. Use valid and reliable outcomes to measure impact; use feedback tools to measure acceptability. |
| 6 | Analyze performance and feedback data for evidence on methods and results; re-deploy | a. Obtain evidence by properly analyzing outcomes and feedback; derive inference. |
| 7 | Keep optimizing | a. Keep improving on the methods of use. |

ASIC for institutional and professional use: In the professional circle, such as the community of practice, ASIC can help to come up with standard practices or recommendations regarding the use of an innovation or EdTech especially when such is new or when an existing EdTech or innovation is being adapted or repurposed. ASIC could help in determining the educational value of such EdTech/innovation and their potential impact. Since the exercise in this instance would normally include a group of experts, the reflective processes that lead to answering ASIC questions and coming up with positive answers would equally lead to generating statements of guidelines on standard practice (see Table *5*).

**TABLE 4: Key steps and considerations on how to use the ASIC framework by a team or group.**

ASIC: Adaptation, Standardization, Integration, and Compliance; EdTech: educational technologies.

|  |  |  |
| --- | --- | --- |
|  | **Key considerations** | **Additional information** |
| 1 | Define the role of EdTech and innovations for educational purposes | a. It is important to clearly define what problem could be solved with an innovation or EdTech or what additional educational value the EdTech could contribute. |
| 2 | Characterize resources that align with educational cultures and drive change; identify EdTech and innovations | a. Based on needs assessment, context, and practical applications, identify the most appropriate EdTech or innovation of choice. |
| 3 | Apply design thinking to determine the key areas of EdTech use; establish KPIs | a. It is good to adopt a model for the design-thinking process - the IDEO model highlights steps that include Empathizing, Ideating, Concepting, Prototyping, and Implementing. What this does is to establish a roadmap for the innovative change process. |
|  |  | b. Key performance indicator (KPI) helps to define the specific functions that EdTech and innovation should perform in any or all the cognitive (knowledge), psychomotor (skills), and affective (attitude) domains to make it work its use and justify resource investment that would be required. |
| 4 | Apply ASIC tool with emphasis on tenets; consider the role of the 4Ps (purpose, people, process, product/outcome) | a. Answer ASIC questions, preferably as a group. |
|  |  | b. Apply prompts to clarify verdicts leading to the answer. |
|  |  | c. Generate a document of 1-3 key considerations on which a favorable answer to each tenet was premised. |
|  |  | d. Carefully curate the document (generated under 4c) into a document that informs the practice that would guide the institutional and professional use of EdTech and innovation. |
| 5 | Initiate change process, define milestones, measure impacts, and obtain feedback | a. Apply a suitable implementation model or strategy for the change process. |
| 6 | Analyze data and feedback; align inferences with the KPIs | a. Data on EdTech performances should be properly analyzed for evidence of impact and justification for continuous use. |
| 7 | Keep optimizing | a. Protocols should be updated continuously, and methods should be improved upon. |

*ASIC and the Educational Ecosystem*

**TABLE 5: Key steps and considerations on how to use the ASIC framework by institutions and professional bodies.**

ASIC: Adaptation, Standardization, Integration, and Compliance; EdTech: educational technologies.

An educational ecosystem may be described as a system of structural and functional domains or systems interconnected by an operational network and governed by established principles and rules toward achieving an educational outcome. In a typical educational ecosystem, the structural components include physical infrastructures and the hardware that help facilitate educational experiences. This might include the physical learning spaces such as classes, laboratories, and simulation rooms; others might include machines and hardware such as computer devices, media, and specific-purpose machines such as the MRI machine in the hospital, microscopes in the laboratory, and high-fidelity mannequins in the simulation laboratories.

The functional components of the ecosystem include activities that enable the use of these infrastructures and resources for facilitating sessions in classrooms, clinics, laboratories, workshops, or open fields, and other contexts of training or practice. With technologies and innovations, the networks that interconnect the structural and functional aspects of the ecosystems could be facilitated by the internet connection, or actual structural and electrical connections, aided or operated by humans or other machines. In the educational ecosystem, humans are their ultimate operators and activities are guided and aided by theories, rules, principles, and standard practices often provided as policies and guidelines.

To operationalize ASIC in an educational ecosystem, the culture of the system is of key importance. Innovations and technologies could significantly shape the culture of an educational system. It is important to carefully assess the current prevalent culture, and define the desired change to the current culture as well

as the process for leading the desired change with innovations and technologies playing key roles. This is why the 4Ps become of key consideration. While ASIC could help individual members of the educational system to develop and optimize technologies and innovation, the entire organization could also use ASIC for leading change with innovations in accordance with the steps indicated for ASIC For Institutional and Professional Use as indicated in the previous section.

The basics of the ASIC algorithm include the features listed in Table *6*.

**TABLE 6: Basics of the ASIC algorithm and their features.**

ASIC: Adaptation, Standardization, Integration, and Compliance; EdTech: educational technologies.

|  |  |  |
| --- | --- | --- |
|  | **Basics of the ASIC algorithm** | **Features** |
| 1 | Interface | The interface has a measuring scale that shows scores of an EdTech ASCI value; there is also a small window that shows the actual score as a percentage. There is a parallel bar that equally presents the score on a scale bar with colors showing the zone of performance with red being on the far left and the worst performance, and green being on the far right and the highest. |
| 2 | Measurement parameters | Each ASIC tenet has three considerations that are to be answered Yes/No. Each Yes response is a score of 1 out of the possible total of 12 or an equivalent percentage. See the questions on the next page. |
| 3 | Operational principles | To answer each question on the software/app, the user will have to click on the ASIC question and click the applicable option out of the Yes/No (no neutral response is allowed). Each Yes response accounts for 1 and a No gives a score of 0. |
| The prompts include strategic questions that are aimed at stimulating ASIC users toward understanding  4 Prompts  the significance of the questions, quality reflections, and providing the most appropriate responses. | | |

Features of the software and the operational interface are presented in Table *7*.

|  |  |  |
| --- | --- | --- |
|  | **Main parts of the software and the operational interface** | **Features** |
| 1 | ASIC web page - landing page | The landing page has concise information that introduces ASIC as an idea and provides the meaning of its four tenets including A - Adaptation, S - Standardization, I - Integration, and C - Compliance. The Landing page has a link to the ASIC dashboard for registrations at first and subsequently log-in. The Landing page further has other very helpful information such as the frequently asked questions and links to various ASIC webpage parts such as the forum. It also has a set of frequently asked questions. |
| 2 | Dashboard | The dashboard has the link to the ASIC test software. It also has other product information and supporting links including forum, subscription, and security. |
| 3 | Access to the software | Access to the functional ASIC software is through the test link on the dashboards. |
| 4 | Operational interface | This interface registers a test; it has provisions for a logo (optional) and the test title. |
| 5 | Software operation | The software is operated by answering the questions with either Yes or No. Prompts are available for further liberation and guidance. |
| 6 | Digital result features | Upon submission, the result is downloaded automatically. A link to keep a permanent copy of the result is also automatically created. Features of a basic result include ASIC scores for a test in all sections and the overall average score and the ASIC verdict. The subscription-level results interface has a dynamic interface with illustrations with a pictogram of test-indicated performances and a barcode. |
| 7 | Interpretation rubrics | The rubric with a comprehensive guide for interpreting the result is also automatically downloaded as a PDF (see Table 8). |
| Other  8 The dashboard has links to offerings such as ASIC courses. considerations | | |

Features of the ASIC framework results interpretation rubric are presented in Table *8* while the interpretations (Adaptation, Standardization, Integration, and Compliance) are provided in Table *9*.

**TABLE 7: Main parts of the software and the operational interface and its features.**

ASIC: Adaptation, Standardization, Integration, and Compliance; EdTech: educational technologies.

**TABLE 8: ASIC framework results interpretation rubric.**

ASIC: Adaptation, Standardization, Integration, and Compliance; EdTech: educational technologies.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | **Poor <60** | **Good 61-70** | **Very good 71-80** | **Excellent 81-90** | **Outstanding 91-100** | **General comment** |
|  | Does not sufficiently | Partially satisfies at | Sufficiently satisfies at least one adaptation- related component of combined CPA requirements |  |  | A less than 2/3 score under Adaptation requires consideration to sufficiently meet the  >2/3 requirement |
|  | satisfy at least one | least one | Sufficiently satisfies at least | Sufficiently satisfies three or |
| Adaptation | adaptation-related  component of | adaptation-related  component of | two adaptation-related  components of combined | more adaptation-related  components of combined |
|  | combined CPA | combined CPA | CPA requirements | CPA requirements |
|  | requirements | requirements |  |  |
|  | Does not sufficiently | Partially satisfies at | Sufficiently satisfies at |  |  | A less than 2/3 score under standardization requires consideration to sufficiently meet the  >2/3 requirement |
|  | satisfy at least one | least one | least one | Sufficiently satisfies at least | Sufficiently satisfies three or |
| Standardization | standardization-related  component of | standardization-  related component | standardization-related  component of | two standardization-related  components of combined | more standardization-related  components of combined |
|  | combined CPA | of combined CPA | combined CPA | CPA requirements | CPA requirements |
|  | requirements | requirements | requirements |  |  |
|  | Does not sufficiently | Partially satisfies at | Sufficiently satisfies at least one integration- related component of combined CPA requirements |  |  | A less than 2/3 score under integration requires consideration to sufficiently meet the  >2/3 requirement |
|  | satisfy at least one | least one | Sufficiently satisfies at least | Sufficiently satisfies three or |
| Integration | integration-related  component of | integration-related  component of | two integration-related  components of combined | more integration-related  components of combined |
|  | combined CPA | combined CPA | CPA requirements | CPA requirements |
|  | requirements | requirements |  |  |
|  | Does not sufficiently | Partially satisfies at | Sufficiently satisfies at least one compliance- related component of combined CPA requirements |  |  | A less than 2/3 score under compliance requires consideration to sufficiently meet the  >2/3 requirement |
|  | satisfy at least one | least one | Sufficiently satisfies at least | Sufficiently satisfies three or |
| Compliance | compliance-related  component of | compliance-related  component of | two compliance-related  components of combined | more compliance-related  components of combined |
|  | combined CPA | combined CPA | CPA requirements | CPA requirements |
|  | requirements | requirements |  |  |
|  |  | Consider all ASIC | Consider ASIC tenets with low ASIC values to improve on EdTech/innovations’ performance requirements | Consolidate ASIC tenet values by improving performance in concerned categories to fully optimize EdTech/innovations’ performance | Sustain ASIC tenets values and translate value to the actual context of use and practice for optimal EdTech/innovations’ performance |  |
|  | Consider all ASIC | tenets to improve on |  |
| Total | tenets to meet | EdTech/innovations’ | ASIC |
|  | minimum requirements | performance |  |
|  |  | requirements |  |

|  |  |
| --- | --- |
| **A** | **S** |
| **Adaptation** | **Standardization** |
| Adaptation implies that innovations and educational technologies or EdTech should be suitably adapted to the learning ecosystem, program design, and institutional system, for optimal performance and best outcomes. | Standardization involves determining clearly the purpose that innovations and technologies serve, the objectives they meet; and supporting their uses with evidence for best and standard practices. It also involves the use of innovations and EdTech in alignment with sound educational and learning principles. |
| **I** | **C** |
| **Integration** | **Compliance** |
| Integration involves creating a place for the use of educational innovations and technology within the immediate teaching or training ecosystem, and aligning its use with other components of the educational system for optimal performance. Key considerations include system thinking and synergy. | Compliance emphasizes alignment with institutional policies, regulations, and practices as well as relevant regulatory requirements (if applicable). Evidence of compliance with institutional standards, program requirements, and regulations of relevant bodies should be addressed. |
| Total score = ASIC value | |

Discussion

**TABLE 9: Interpretation of ASIC tenets.**

ASIC: Adaptation, Standardization, Integration, and Compliance; EdTech: educational technologies.

**Significance of the digitized ASIC Framework CPA operational matrix**

The rapid nature of educational changes as driven by technology and innovations, coupled with a lack of requisite knowledge of educational principles that apply to EdTech and innovations coupled with a lack of practical skills to apply them has created significant heterogeneities in the methods, manners, and strategies for leading change with innovations as well as skillful and effective deployment of EdTech and innovations for optimal educational experiences. Heterogeneity, therefore, has emerged as a major problem with Edtech for educational activities. There are clear cases of heterogeneities in the types of EdTech that are available for similar educational purposes, i.e. validating the vast number of options to choose from when seeking to use tech and innovations for educational purposes. Interestingly, the eventual choices are not often premised on empirical evidence or educational values or based on guiding principles but on sentiments that bother expert opinions, availability of funds, and institutional agenda. Where existing theories and principles can be applied to guide EdTech use, many experts lack the requisite knowledge of such fundamentals or the skills and capacity to apply them in their judgments of choice and methods of use. Another source of heterogeneities is the indiscriminate use of technologies to achieve pedagogical activities that are somewhat traditional or well established without recourse to the use of evidence and application of principles to ensure the validity and reliably of the innovations or EdTech to achieve similar or better outcomes with the EdTech or innovations relative to the established principles.

Often, short-term gains and immediate but arguably unsustainable results are considered as the main sources of motivation.

The ASIC framework was initially developed and has four key tenets, namely Adaptation, Standardization, Integration, and Compliance. These key tenets were organized into a functional framework, from which an algorithm was developed to optimize it for determining the validity and reliability of an

educational innovation or technology to optimally provide an educational experience with emphasis on the curriculum, pedagogy, and assessment. Furthermore, the ASIC framework was matrices that could help in guiding an educator to creatively and quantitatively determine the potential impact of an EdTech or innovation within an educational ecosystem. This algorithm has been effectively digitalized. It is

now available as a web-hosted software with alternative versions in the form of apps on IOS and Windows platforms. This article presents the experience as a whole. It could provide quality guidance to other educational innovators. It also serves the purpose of guiding educators on how best to optimize

their innovations and EdTech for optimal learning experiences for their learners and trainees. The fact that several types of technologies and innovations can be suitably adapted and integrated into a medical or health education program using the ASIC framework is important. ASIC can guide strategic advancements with technologies and innovations in medical education with diverse products including Artificial Intelligence (AI), noting that the value of AI in medical education and care is now being seriously explored [36,37].

**The problem of heterogeneities in relation to EdTech and innovations for medical and ASIC-derived solutions**

There is no doubt that with the increase in advancements in technology and innovation, there will be several new types of innovations or technologies that can be used for medical education and, by extension, higher education in general. The implication of this is that there will be more varieties of tech innovations from which educators are required to choose. With more choices available, the reality of using a wide range of innovative approaches and technologies for similar purposes in different contexts of medical education will also come to light. An abundance of choice in terms of the available innovations or tech might not be a problem in itself, but heterogeneity would definitely result if standards are not set with clear guiding principles. Understandably, not all educators have extensive expertise in the primary domains of medical education in addition to their scientific and clinical competencies. The implication of this reality is that the

requisite knowledge and competence to make informed decisions about the most appropriate technology and innovations in relation to the pedagogical framework to use would vary from place to place.

This is therefore why a case is being made for the use of a tested and standardized framework such as the ASIC. Not only is this framework premised on clearly stated educational theories and pedagogical principles, but it also has the versatility that supports its deployment in almost any context of medical education. It is also not cumbersome for educators to understand, especially in terms of its operational principles and applications. Clearly, digitizing this framework is also a way to democratize it and make it readily available to people in almost any part of the world. This is arguably one of the most educational frameworks with clearly listed pedagogical principles of the 21st century that address the use of innovation and technologies for medical education.

It is important to state that, unlike several other existing pedagogical frameworks that use descriptive attributes and guiding principles, the ASIC also has a quantitative approach to its use, a measure of impact, and an interpretation of the same. It is clearly a modern pedagogical framework that ranks favorably in terms of application with other popularly used pedagogical frameworks such as Kolb’s learning cycle, Argyris and Schon’s loops, Bloom’s taxonomy, and Miller’s pyramid. Nevertheless, credit should be given to the proponents of all relevant existing theories of learning and pedagogical frameworks, since they form the basis of scientific evidence to support the application and validity of the ASIC framework. It is highly recommended for individual educators, irrespective of their level of proficiency and experience, as it can objectively and consistently guide the decision-making processes regarding which type of educational technology and innovations to adopt, and more importantly, how to use such innovations or tech consistently and in line with learning theories and pedagogical principles. It is equally highly recommended to institutions and communities of practice. ASIC is arguably the only tool available currently to institutions and communities of practice to collaboratively make decisions on the best and most appropriate type of innovations and EdTech to adopt, and to justify the implementation plan by considering the four key tenets of adaptation, standardization, integration, and compliance. Furthermore, it emphasizes all the primary domains of learning, which include cognitive, psychomotor, and affective.

Also, it is important to further highlight that the problem of heterogeneity is not just about the diverse types of educational innovations and technologies that are available, but also the variations that exist in how they are used for similar purposes in different places and at different times. This aspect of heterogeneity regarding the use of EdTech and innovations can impact the qualities of validity and reliability, which are key attributes that define the assessment of learning and consequently provide justification for the acquisition of competencies. When an assessment cannot be adjudged to be valid and reliable following the use of technology and innovations, not just at the level of individual sessions or institutions but across professional settings, there arises a very important need to ensure that technologies and innovations are used in alignment with curriculum requirements, in line with sound learning theories and pedagogical principles, and validly and reliably in line with assessment principles.

ASIC remains a foremost framework that has been able to connect curriculum, pedagogy, and assessment, such that when similar technologies and innovations are used in different institutions or professional contexts, adherence to each tenet and attainment of positive indicators regarding the prospect of the innovation or EdTech in relevant domains of education and training would provide a justification for the use of technology for pedagogical purposes and justify ensuing results in assessments that have been valid and reliable. Therefore, in addition to guiding pedagogical approaches to using innovation and EdTech, ASIC also provides the basis for establishing the reliability and validity of assessments. Very importantly, this is done with a big picture of the entire program and its desired outcomes often defined by stated competencies.

**Promoting a culture of best practice**

One of the realities that has emerged as a result of gaps in the resources available to different institutions in various places is the significant potential gap in what constitutes standard practices across institutions that claim to train medical and health professionals. These professionals are expected to acquire similar levels of competencies at the end of their training. If the inequity that the disproportionate availability of resources to different institutions creates takes medical education back to a scenario similar to what existed prior to

Flexner’s reform of the early 1900s, the quality of medical education could vary significantly across institutions because there were no regulations that set the standard for best practices [38,39].

It is important to state that products of EdTech and innovation are required to provide technical guides and manuals, in addition to commercials that promote products often supported with the best available evidence to support the usefulness of their product with a bias for positive outcomes. To their credit, some of these producers also work with technology enthusiasts as well as a selected group of tech-competent medical educators. Nevertheless, it is also important to state that these relationships do not necessarily contribute to best practices at the institutional level. Instead, they help the producers optimize their products for the best user experiences and, subsequently, patronage. Therefore, it remains the responsibility of stakeholders in medical education to set standards regarding best practices that will guide the use of innovation and tech for medical education. This aligns with calls to address both educators’ tech and pedagogical competencies in order to properly use technologies and innovation for medical education [40].

Therefore, tech-competent medical educators have a responsibility to develop innovations and present innovative ideas that are products of not just their education but also their experience in practice. They blend, weave, distill, and curate evidence available in synthesized literature, then premise it on appropriate learning theories, pedagogical frameworks, and professional standards. This process, as described, is exactly what has yielded their significant work. It is therefore important to say that the ASIC framework, as an instrument, has significant value in contributing to promoting the culture of best practices in medical education and related communities of practice. It is also important to state that other existing pedagogical frameworks that have been listed or mentioned in this article were created at a certain point in time by competent educators, and they were continually applied and oftentimes refined to support educational activities. It would appear that the development of the ASIC framework also has a place in the timeline of the history of education as a tool that could address the current trend characterized by significant adoption and use of innovations and technologies for medical and higher education.

**Using ASIC to counter neo-Luddism**

The Luddite movement was responsible for a major campaign against the introduction of technology into the textile industry in Europe. From this event, attempts to resist the introduction of technology into a particular domain in the years that followed this historical event have been dubbed “Neo-Luddism”. The problem of neo-Luddism has often been touted as opposition to the use of technology for medical education in certain instances, and the actors involved are often dubbed neo-Luddites or anti-technology people [41- 44]. However, it is important to highlight that oftentimes people who resist technology or who are rather indifferent but unimpressed at the same time are often cautious about the negatively disruptive tendencies of certain technologies or poorly integrated innovative approaches. Even in the context of E-Health, three groups of non-adopters of E-Health technology have been identified as postponers, opponents, and critics, with the postponers and opponents groups including patients and families of patients [45]. Instances of failed attempts to deploy technology for educational purposes have reinforced resistant behavior in certain instances.

It is therefore important to understand that the use of evidence and a pedagogical framework to promote the use of technology, with an effort to not just promote standard practices but to continuously evaluate the performance of innovations and technology, could help address Neo-Luddism and provide convincing evidence to Neo-Luddites tech-ethicists. Tech ethicists are a group of people who insist that technologies are not used to break existing rules or disrupt existing orders in education. Noting that the introduction and integration of major technologies or innovations in an aspect of education could have a ripple effect, the use of a pedagogical framework can help to properly analyze the prospect and potential effects and to ensure that they are positive in terms of the impact that they might make in other aspects or domains of medical education. This argument, as presented here, is another strong indication of why the ASIC framework could be very significant to the advancement of modern medical education and should be given serious consideration by medical educators and other stakeholders, including academic leaders. People’s appreciation for the use of technologies in medicine currently varies significantly; with better education, exposure, and promotion of best practices, educators, professionals, and patients will increasingly appreciate the value of technologies [46].

**Importance of ASIC to stakeholders - educators, administrators, instructional designers, and academic leaders**

Much of the case that has been made for a need to standardize the use of EdTech and innovation has emphasized the importance of a standard framework for the job of medical educators. Administrators can also be better guided in making decisions on the choice of technologies to procure and in developing a plan to integrate technologies and innovation into the educational ecosystem while assuring value for the investment of resources and capital. For instructional designers, it is important for them to consider the specific innovation or technology that is being introduced and the impact of the same on the existing educational and infrastructure ecosystem. For example, it might be important to consider how a new technology, such as educational software, might be integrated into the existing learning management system with optimized access provided to the student. It might also be important to consider how other

resources that are already in existence will be functionally connected with a newly introduced technology or innovation such that they can run in sync for an optimal student experience. More than ever before, instructional designers have to consider not just the prospect of a particular edtech or innovation based on its performance, but also its synchronization with other components of the educational ecosystem.

Academic leaders are often required to ultimately make decisions regarding the innovations and technologies to be procured for their various programs or groups of students. There are times when they are required to consider cases or even arguments as presented by educators and other stakeholders. Using a framework such as the ASIC can guide all these stakeholders in working collaboratively to arrive at the best possible decisions by aligning paradigms, while at the same time considering the value of technologies and innovations based on their potential educational value or impact. For example, it is possible that a newly developed sophisticated technology might not be adding significant value to the program based on competencies that are required of students, even when the proponents are quite enthusiastic about its futuristic value. A practical framework can therefore help an academic leader to judge innovation and technology based on its value for money and return on investment, in addition to the actual educational value. Should there be an instance where an institution chooses to be a trailblazer by pushing the boundary of training by considering the use of a particular technology or innovation that is not already aligned with stated competencies to be acquired through a program, a standard framework such as the ASIC might still be able to help in carefully measuring what is to be committed to such effort while ensuring that it is not done at the expense of the already established and identified outcomes, which might be used by regulators and institutional standards to judge the success of the program? Academic leaders, especially, should also be aware that a major way to capitalize on the value that Edtech and innovation could add to the future of medical education is to start enshrining a healthy culture of technology into medical education right from now. Future doctors and health workers would practice in a tech-enriched environment where they need to be exposed adequately to technology during their training [19,47,48].

Conclusions

EdTech and innovations including educational devices and AI have significant roles in delivering medical education. The vast variety of EdTech and innovations available to educators as well as the different pedagogical approaches to using the EdTech and innovations have created a problem of heterogeneities that could undermine standardized educational experiences. There are currently no major tools and frameworks to guide EdTech deployment and optimization, hence the place of ASIC as a foremost framework for guiding the deployment of EdTech or innovations and their optimization. The ASIC framework has four tenets including Adaptation, Standardization, Integration, and Compliance. This article has presented the process of digitalizing the ASIC framework as an innovation. It has also provided provided information to guide users.

Additional Information

**Author Contributions**

All authors have reviewed the final version to be published and agreed to be accountable for all aspects of the work.

**Concept and design:** Joshua Owolabi

**Acquisition, analysis, or interpretation of data:** Joshua Owolabi

**Drafting of the manuscript:** Joshua Owolabi

**Critical review of the manuscript for important intellectual content:** Joshua Owolabi

**Disclosures**

**Human subjects:** All authors have confirmed that this study did not involve human participants or tissue.

**Animal subjects:** All authors have confirmed that this study did not involve animal subjects or tissue. **Conflicts of interest:** In compliance with the ICMJE uniform disclosure form, all authors declare the following: **Payment/services info:** All authors have declared that no financial support was received from any organization for the submitted work. **Financial relationships:** All authors have declared that they have no financial relationships at present or within the previous three years with any organizations that might have an interest in the submitted work. **Other relationships:** All authors have declared that there are no other relationships or activities that could appear to have influenced the submitted work.

References

1. [Lin F, Fofanah SS, Liang D: Assessing citizen adoption of e-Government initiatives in Gambia: A validatio](https://dx.doi.org/10.1016/j.giq.2010.09.004)n [of the technology acceptance model in information systems success. Gov Inf Q. 2011, 28:271-9.](https://dx.doi.org/10.1016/j.giq.2010.09.004) [10.1016/j.giq.2010.09.004](https://dx.doi.org/10.1016/j.giq.2010.09.004)
2. Muk A, Chung C: [Applying the technology acceptance model in a two-country study of SMS advertising](https://dx.doi.org/10.1016/j.jbusres.2014.06.001) . J

Bus Res. 2015, 68:1-6. [10.1016/j.jbusres.2014.06.001](https://dx.doi.org/10.1016/j.jbusres.2014.06.001)

1. Taherdoost H: [A review of technology acceptance and adoption models and theories](https://dx.doi.org/10.1016/j.promfg.2018.03.137) . Procedia Manuf. 2018, 22:960-7. [10.1016/j.promfg.2018.03.137](https://dx.doi.org/10.1016/j.promfg.2018.03.137)
2. [Moran J, Briscoe G, Peglow S: Current technology in advancing medical education: Perspectives for learnin](https://dx.doi.org/10.1007/s40596-018-0946-y)g [and providing care. Acad Psychiatry. 2018, 42:796-9.](https://dx.doi.org/10.1007/s40596-018-0946-y) [10.1007/s40596-018-0946-y](https://dx.doi.org/10.1007/s40596-018-0946-y)
3. [Lima D, Sotero V, Dermeval D, Artur J, Passos F: A systematic review on the use of educational technologie](https://dx.doi.org/10.5220/0007678501530160)s [for medical education. Proceedings of the 11th International Conference on Computer Supported Education](https://dx.doi.org/10.5220/0007678501530160) (CSEDU 2019), pp. 153-160. 2019, [10.5220/0007678501530160](https://dx.doi.org/10.5220/0007678501530160)
4. AlQudah AA, Al-Emran M, Shaalan K: [Technology acceptance in healthcare: A systematic review](https://dx.doi.org/10.3390/app112210537). Appl Sci. 2021, 11:10537. [10.3390/app112210537](https://dx.doi.org/10.3390/app112210537)
5. [Linderman SW, Appukutty AJ, Russo MV, Shah AP, Javaherian K: Advancing healthcare technology education and innovation in academia. Nat Biotechnol. 2020, 38:1213-7.](https://dx.doi.org/10.1038/s41587-020-0689-7) [10.1038/s41587-020-0689-7](https://dx.doi.org/10.1038/s41587-020-0689-7)
6. Fallavollita P: [Innovative technologies for medical education](https://dx.doi.org/10.5772/intechopen.68775) . InTech. 2017, [10.5772/intechopen.68775](https://dx.doi.org/10.5772/intechopen.68775)
7. [Kim JW, Myung SJ, Yoon HB, Moon SH, Ryu H, Yim JJ: How medical education survives and evolves durin](https://dx.doi.org/10.1371/journal.pone.0243958)g [COVID-19: Our experience and future direction. PLoS One. 2020, 15:e0243958.](https://dx.doi.org/10.1371/journal.pone.0243958) [10.1371/journal.pone.0243958](https://dx.doi.org/10.1371/journal.pone.0243958)
8. [Alsoufi A, Alsuyihili A, Msherghi A, et al.: Impact of the COVID-19 pandemic on medical education: Medica](https://dx.doi.org/10.1371/journal.pone.0242905)l [students' knowledge, attitudes, and practices regarding electronic learning. PLoS One. 2020, 15:e0242905.](https://dx.doi.org/10.1371/journal.pone.0242905) [10.1371/journal.pone.0242905](https://dx.doi.org/10.1371/journal.pone.0242905)
9. [Owolabi J, Bekele A: Medical educators' reflection on how technology sustained medical education in th](https://dx.doi.org/10.1177/20552076211059358)e [most critical times and the lessons learnt: Insights from an African medical school. Digit Health. 2021,](https://dx.doi.org/10.1177/20552076211059358) 7:20552076211059358. [10.1177/2055207621105935](https://dx.doi.org/10.1177/20552076211059358)8
10. [Tuma F, Kamel MK, Shebrain S, Ghanem M, Blebea J: Alternatives surgical training approaches during COVID-19 pandemic. Ann Med Surg (Lond). 2021, 62:253-7.](https://dx.doi.org/10.1016/j.amsu.2021.01.057) [10.1016/j.amsu.2021.01.057](https://dx.doi.org/10.1016/j.amsu.2021.01.057)
11. [Jeffries PR, Bushardt RL, DuBose-Morris R, et al.: The role of technology in health professions education during the COVID-19 pandemic. Acad Med. 2022, 97:S104-9.](https://dx.doi.org/10.1097/ACM.0000000000004523) [10.1097/ACM.0000000000004523](https://dx.doi.org/10.1097/ACM.0000000000004523)
12. [Alsaif BS, Ibrahem UM, Alblaihed MA, et al.: Medical education and the epidemics: How educationa](https://www.jstor.org/stable/27288771)l [technology responded. Afr J Reprod Health. 2024, 28:94-109.](https://www.jstor.org/stable/27288771)
13. [Liang JZ, Ng DK, Raveendran V, et al.: The impact of online education during the Covid-19 pandemic on th](https://dx.doi.org/10.1371/journal.pone.0296367)e [professional identity formation of medical students: A systematic scoping review. PLoS One. 2024,](https://dx.doi.org/10.1371/journal.pone.0296367) 19:e0296367. [10.1371/journal.pone.0296367](https://dx.doi.org/10.1371/journal.pone.0296367)
14. [Voss M, Geniets A, Winters N: Strategies for digital clinical teaching during the COVID pandemic: A scopin](https://dx.doi.org/10.1007/s40670-023-01894-w)g [review. Med Sci Educ. 2024, 34:219-35.](https://dx.doi.org/10.1007/s40670-023-01894-w) [10.1007/s40670-023-01894-w](https://dx.doi.org/10.1007/s40670-023-01894-w)
15. [Owolabi J: Proposing a framework guide for the integration of educational technologies and innovation](https://dx.doi.org/10.2147/AMEP.S338262)s [into the teaching of anatomy and medical sciences: The ASIC framework. Adv Med Educ Pract. 2021,](https://dx.doi.org/10.2147/AMEP.S338262) 12:1277-82. [10.2147/AMEP.S33826](https://dx.doi.org/10.2147/AMEP.S338262)2
16. [Owolabi J: ASIC framework simplified and operationalised - An operational matrix for optimising the use of technologies and innovations in medical education. Adv Med Educ Pract. 2022, 13:149-56.](https://dx.doi.org/10.2147/AMEP.S351642) [10.2147/AMEP.S35164](https://dx.doi.org/10.2147/AMEP.S351642)2
17. [Owolabi JO: The ASIC framework: An alternative operational matrix to support the technology an](https://dx.doi.org/10.30476/ijvlms.2022.93833.1125)d [innovations in medical education based on the primary learning domains. Interdiscip J Virtual Lea](https://dx.doi.org/10.30476/ijvlms.2022.93833.1125)rn Med Sci. 2022, 13:141-7. [10.30476/ijvlms.2022.93833.1125](https://dx.doi.org/10.30476/ijvlms.2022.93833.1125)
18. [Owolabi JO, Ojiambo R, Seifu D, Nishimwe A, Masimbi O, Okorie E, Ineza D: A study of anatomy teachers' perception and acceptance of the anatomage table technology and digital teaching materials in the training of medical and allied health students. Cureus. 2022, 14:e32163.](https://dx.doi.org/10.7759/cureus.32163) [10.7759/cureus.32163](https://dx.doi.org/10.7759/cureus.32163)
19. [Owolabi J, Ojiambo R, Seifu D, et al.: African medical educators and anatomy teachers' perceptions an](https://dx.doi.org/10.2147/AMEP.S358702)d [acceptance of the anatomage table as an EdTech and innovation: A qualitative study. Adv Med Educ Pr](https://dx.doi.org/10.2147/AMEP.S358702)act. 2022, 13:595-607. [10.2147/AMEP.S35870](https://dx.doi.org/10.2147/AMEP.S358702)2
20. [Owolabi J, Grant P: EdTech and Innovations for Anatomical Education in the 21st Century- A Scopin](https://scholar.google.com/scholar?q=intitle%3AEdTech%20and%20Innovations%20for%20Anatomical%20Education%20in%20the%2021st%20Century-%20A%20Scoping%20Review.%20MSc%20Medical%20Education%20Thesis%2C%20University%20of%20South%20Wales%2C%20UK)g [Review. MSc Medical Education Thesis, University of South Wales, UK. 2022.](https://scholar.google.com/scholar?q=intitle%3AEdTech%20and%20Innovations%20for%20Anatomical%20Education%20in%20the%2021st%20Century-%20A%20Scoping%20Review.%20MSc%20Medical%20Education%20Thesis%2C%20University%20of%20South%20Wales%2C%20UK)
21. Knowles MS: [The Modern Practice of Adult Education: From Pedagogy to Andragogy](https://www.umsl.edu/~henschkej/articles/a_The_%20Modern_Practice_of_Adult_Education.pdf) . Cambridge, New York; 1980.
22. Lowe SD: [Adult learning theory and online learning](https://books.google.co.in/books?id=JQIoDwAAQBAJ&printsec=frontcover&source=gbs_ge_summary_r&cad=0%23v%3Donepage&q&f=false) . Best Practices of Online Education: A Guide for Christian Higher Education. Maddix MA, Estep JR, Lowe ME (ed): IAP Information Age Publishing, Charlotte, NC; 2012. 17-30.
23. Plass JL, Moreno R, Brünken R: [Cognitive Load Theory](https://dx.doi.org/10.1017/CBO9780511844744). Cambridge University Press, Cambridge, UK; 2010. [10.1017/CBO9780511844744](https://dx.doi.org/10.1017/CBO9780511844744)
24. Sweller J: [Cognitive load theory](https://dx.doi.org/10.1016/B978-0-12-387691-1.00002-8). The Psychology of Learning and Motivation: Cognition in Education. [Mestre JP, Ross BH (ed): Elsevier Academic Press, Cambridge, MA; 2011. 37-76. 10.1016/B978-0-12-387691](https://dx.doi.org/10.1016/B978-0-12-387691-1.00002-8)- [1.00002-8](https://dx.doi.org/10.1016/B978-0-12-387691-1.00002-8)
25. Miller GE: [The assessment of clinical skills/competence/performance](https://dx.doi.org/10.1097/00001888-199009000-00045) . Acad Med. 1990, 65:S63-7. [10.1097/00001888-199009000-00045](https://dx.doi.org/10.1097/00001888-199009000-00045)
26. [Witheridge A, Ferns G, Scott-Smith W: Revisiting Miller's pyramid in medical education: The gap between traditional assessment and diagnostic reasoning. Int J Med Educ. 2019, 10:191-2.](https://dx.doi.org/10.5116/ijme.5d9b.0c37) [10.5116/ijme.5d9b.0c37](https://dx.doi.org/10.5116/ijme.5d9b.0c37)
27. Kolb DA: [Experiential Learning: Experience as the Source of Learning, Vol. 1](https://www.researchgate.net/publication/235701029_Experiential_Learning_Experience_As_The_Source_Of_Learning_And_Development) . Prentice-Hall, Englewood Cliffs, NJ; 1984.
28. [Wijnen-Meijer M, Brandhuber T, Schneider A, Berberat PO: Implementing Kolb´s experiential learning cycl](https://dx.doi.org/10.1177/23821205221091511)e [by linking real experience, case-based discussion and simulation. J Med Educ Curric Dev. 2022,](https://dx.doi.org/10.1177/23821205221091511) 9:23821205221091511. [10.1177/2382120522109151](https://dx.doi.org/10.1177/23821205221091511)1
29. Bloom BS: [Taxonomy of Educational Objectives, Handbook: The Cognitive Domain](https://eclass.uoa.gr/modules/document/file.php/PPP242/Benjamin%20S.%20Bloom%20-%20Taxonomy%20of%20Educational%20Objectives%2C%20Handbook%201_%20Cognitive%20Domain-Addison%20Wesley%20Publishing%20Company%20%281956%29.pdf) . David McKay Publications, Philadelphia, PA; 1956.
30. Adams NE: [Bloom's taxonomy of cognitive learning objectives](https://dx.doi.org/10.3163/1536-5050.103.3.010) . J Med Libr Assoc. 2015, 103:152-3. [10.3163/1536-5050.103.3.010](https://dx.doi.org/10.3163/1536-5050.103.3.010)
31. Fleming ND, Mills C: [Not another inventory, rather a catalyst for reflection](https://dx.doi.org/10.1002/j.2334-4822.1992.tb00213.x). Improv Acad J Educ Dev. 1992,

11:137. [10.1002/j.2334-4822.1992.tb00213.x](https://dx.doi.org/10.1002/j.2334-4822.1992.tb00213.x)

1. Brumpton K, Kitchener S, Sweet L: [Learning styles in vertically integrated teaching](https://dx.doi.org/10.1111/tct.12024) . Clin Teach. 2013, 10:282-6. [10.1111/tct.12024](https://dx.doi.org/10.1111/tct.12024)
2. [ASIC EdTech Framewor](https://asicedtech.com/)k. (2024). Accessed: May 19, 2024: [https://asicedtech.com](https://asicedtech.com/)/.
3. [Zhang W, Cai M, Lee HJ, Evans R, Zhu C, Ming C: AI in medical education: Global situation, effects and challenges. Educ Inf Technol. 2023, 29:1-23.](https://dx.doi.org/10.1007/s10639-023-12009-8) [10.1007/s10639-023-12009-8](https://dx.doi.org/10.1007/s10639-023-12009-8)
4. [Sridharan K, Sequeira RP: Artificial intelligence and medical education: Application in classroom instruction and student assessment using a pharmacology &amp; therapeutics case study. BMC](https://dx.doi.org/10.1186/s12909-024-05365-7) Med Educ. 2024, 24:431. [10.1186/s12909-024-05365-7](https://dx.doi.org/10.1186/s12909-024-05365-7)
5. Flexner A: [Medical Education in the United States and Canada](http://archive.carnegiefoundation.org/publications/pdfs/elibrary/Carnegie_Flexner_Report.pdf). The Merrymount Press, Boston; 1910.
6. Duffy TP: [The Flexner report ― 100 years later](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3178858/) . Yale J Biol Med. 2011, 84:269-76.
7. Ertmer PA: [Addressing first- and second-order barriers to change: Strategies for technology integration](https://dx.doi.org/10.1007/BF02299597) . Educ Technol Res Dev. 1999, 47:47-61. [10.1007/BF02299597](https://dx.doi.org/10.1007/BF02299597)
8. Sale K: [The achievements of 'General Ludd': A brief history of the Luddites](http://ink.gale.com/apps/doc/A55576275/AONE?u=txshrpub100416&sid=googleScholar&xid=ce32a20) . Ecologist. 1999, 29:310.
9. Jones SE: [Against Technology: From the Luddites to Neo-Luddism](https://www.routledge.com/Against-Technology-From-the-Luddites-to-Neo-Luddism/Jones/p/book/9780415978682). Routledge, New York; 2006.
10. Cohen AF, Ritter JM: [Industrialized research in the BJCP: A neo-Luddite view](https://dx.doi.org/10.1111/bcp.12000) . Br J Clin Pharmacol. 2012, 74:903-6. [10.1111/bcp.12000](https://dx.doi.org/10.1111/bcp.12000)
11. [McGowan K, Geobey S: Harmful to the commonality: The Luddites, the distributional effects of systems](https://dx.doi.org/10.1108/SEJ-11-2020-0118) [change and the challenge of building a just society. Soc Enterp J. 2022, 18:306-20. 10.1108/SEJ-11-2020](https://dx.doi.org/10.1108/SEJ-11-2020-0118)- [0118](https://dx.doi.org/10.1108/SEJ-11-2020-0118)
12. [Abdellatif AB, Djellal A, Abdellatif T, Ismail I: Study of resistance to digital applications in healthcar](https://ssrn.com/abstract%3D2911066)e [organizations. J Hum Cult Stud. 2017, 2:1-20.](https://ssrn.com/abstract%3D2911066)
13. [Safi S, Thiessen T, Schmailzl KJ: Acceptance and resistance of new digital technologies in medicine](https://dx.doi.org/10.2196/11072): [Qualitative study. JMIR Res Protoc. 2018, 7:e11072.](https://dx.doi.org/10.2196/11072) [10.2196/11072](https://dx.doi.org/10.2196/11072)
14. [Han ER, Yeo S, Kim MJ, Lee YH, Park KH, Roh H: Medical education trends for future physicians in the era o](https://dx.doi.org/10.1186/s12909-019-1891-5)f [advanced technology and artificial intelligence: An integrative review. BMC Med Educ. 2019, 19:460.](https://dx.doi.org/10.1186/s12909-019-1891-5) [10.1186/s12909-019-1891-](https://dx.doi.org/10.1186/s12909-019-1891-5)5
15. Thibault GE: [The future of health professions education: Emerging trends in the United States](https://dx.doi.org/10.1096/fba.2020-00061) . FASEB Bioadv. 2020, 2:685-94. [10.1096/fba.2020-0006](https://dx.doi.org/10.1096/fba.2020-00061)1

**Open Access Technical Report**

**Review began** 12/24/2024 **Review ended** 01/07/2025 **Published** 01/09/2025

**© Copyright** 2025

Owolabi. This is an open access article distributed under the terms of the Creative Commons Attribution License CC-BY 4.0., which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

**DOI:** 10.7759/cureus.77191

#### Digitized ASIC (Adaptation, Standardization, Integration, and Compliance) Framework: An Innovation for Optimizing Technologies and Innovations for Medical and Higher Education

[Joshua Owolabi](https://www.cureus.com/users/492388-joshua-owolabi) 1

1. Department of Biomedical Sciences, Philadelphia College of Osteopathic Medicine, Moultrie, USA

**Corresponding author:** Joshua Owolabi, [joshuaow@pcom.edu](mailto:joshuaow@pcom.edu)

Abstract

This article serves several specific purposes: Presenting transferable information on transforming innovative ideas into educational products with practical applications; showcasing a digitized version of a leading innovation aimed at optimizing technologies and innovations in medical education, health professions education, and higher education; advancing an evidence-based approach to integrating innovations into educational ecosystems and promoting education through innovations and technologies. A 10-step approach to developing the ASIC framework (ASIC stands for Adaptation, Standardization, Integration, and Compliance) is presented, with explanations and illustrations of the processes and activities involved.

Empirical evidence and sound principles are provided in support of activities to assure the validity and reliability of methods or procedures. The product of this innovative process is presented and described for the benefit of educators, academic leaders, and industry stakeholders on evidence-based practical approaches to deploying technologies for educational purposes to benefit learners or teachers, and the general society. The ASIC framework's four tenets, which include Adaptation, Standardization, Integration, and Compliance, are clearly defined. Evidence is presented to support ASIC tenets’ roles in deploying educational technologies and innovations, as well as in transformation agendas involving leading changes with innovation. Possible applications of this successful approach to educational change agenda and roles are also presented. Adequate reference is made to a need to premise interventions on relevant theories and principles including the adult learning theory, cognitive load theory, Bloom’s taxonomy, and connectivism. The IDEO model for leading change with innovation is also highlighted. This article could help educators, innovators, and other stakeholders by providing evidence on methodical approaches to developing and deploying useful innovations.

**Categories:** Medical Education, Medical Simulation, Healthcare Technology

**Keywords:** adaptation, artificial intelligence (ai), asic, compliance, framework, higher education, innovations, integration, medical education, standardization

Introduction

Educational technologies (EdTech) and innovations have become increasingly integral to other education in general, and especially for medical education and health professional education. This is largely a reflection of general advancements in technologies, innovations, and ways of life that have largely been based on technology. It is also a reflection of the transitions from the industrial age to the information age and the emphasis on the use of cutting- or bleeding-edge approaches to driving changes and creating solutions which in turn is largely technology-dependent. More specifically, there are numerous arguments supported by abundant evidence on the importance of technologies and innovations in support of medical education, medical practice, and health professions. In a world, that is being increasingly tech-driven, the culture of technology has significantly permeated medical, professional, and higher education. In fact, imbuing a tech culture into medical training and practice has arguably become a major aspect of emphasis toward training workers and professionals for the current places of work and is very important to meet the needs of the future demands in workplaces. Graduates and professionals without technological skills would not only have lacked vital skills but would also be alien to the emerging culture of work. People’s acceptance or aversions to technology could be complicated but are not impossible to explain. For example, the technology acceptance model (TAM) posits that users are motivated to use technology by three factors, namely, perceived usefulness, perceived ease of use, and attitude toward use [1-3].

There is evidence that technology is increasingly becoming integral to medical education and health service delivery [4-6]. This is true at the discipline level, such as in anatomy [7] and for medical education in general [8]. The COVID-19 pandemic highlighted the significant value of EdTech, digital innovation, and online learning in supporting and sustaining both medical education and healthcare delivery. This successful adaptation served as a crucial eye-opener, demonstrating the essential role of digital resources in advancing medical and health education while enhancing healthcare delivery systems [9-16].

**How to cite this article**

Owolabi J (January 09, 2025) Digitized ASIC (Adaptation, Standardization, Integration, and Compliance) Framework: An Innovation for Optimizing Technologies and Innovations for Medical and Higher Education. Cureus 17(1): e77191. DOI 10.7759/cureus.77191

Having established the place of innovation and EdTech in today's educational ecosystem, it is important to further highlight the place of technologies and innovations and their continuous deployment for educational purposes. One thing is clear, technology influences not just the use of technologies for educational activities but also the established methods, traditional practices, and, consequently, the culture of education and practice. In other words, technology used for educational purposes could influence the knowledge, skills, and attitudes of not just the learners and trainees but also the educators and trainers as

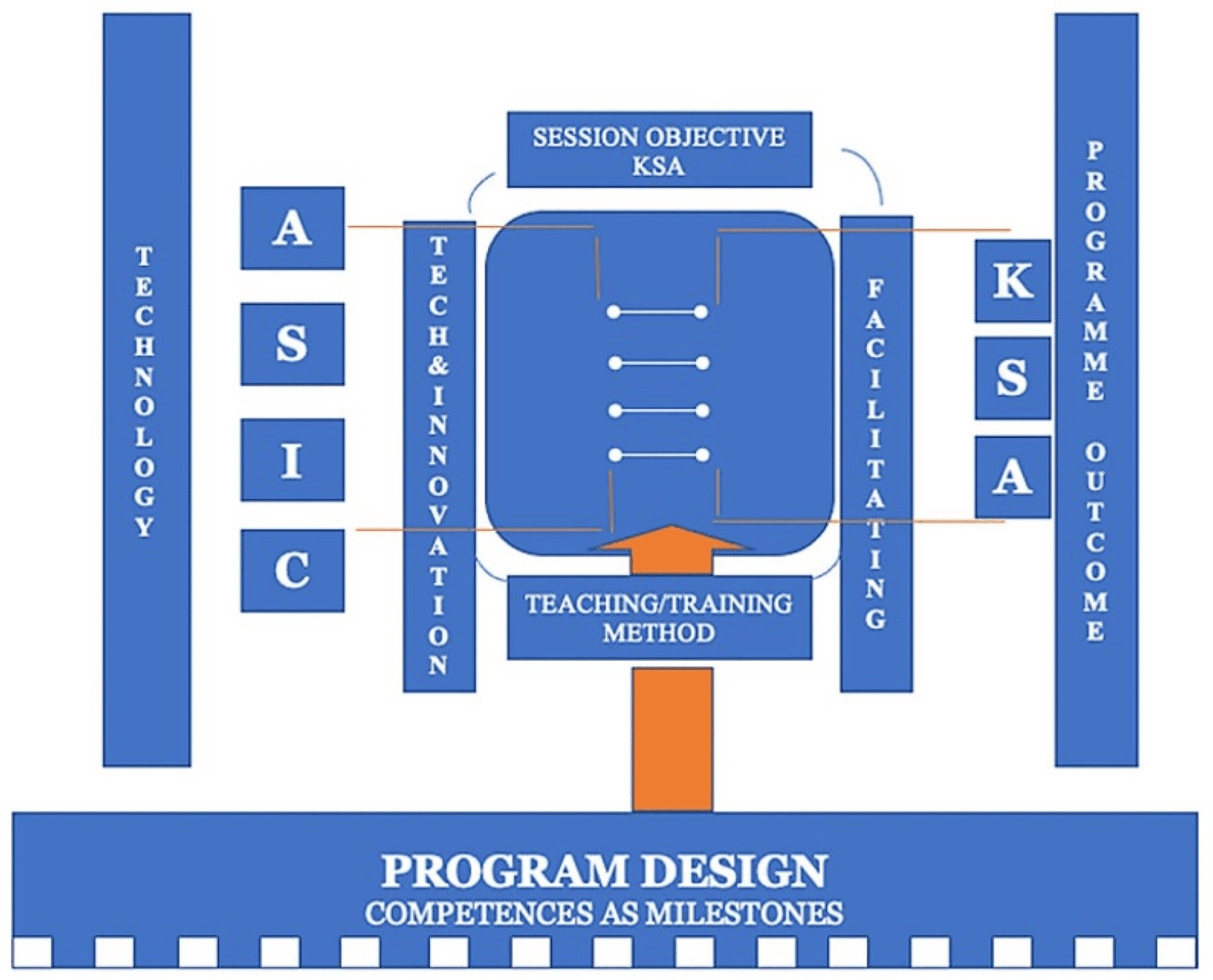
well. This last statement explains why the use of technology would require critical considerations, references to empirical evidence, and adherence to guiding principles and relevant theories. Poor consideration for standard practices, pedagogical principles, and relevant learning theories has resulted in observable heterogeneities in methods of EdTech use and the impacts they produce on learners. This needs to be addressed. It is in line with these realities that the ASIC framework for guiding the use of EdTech and innovation for medical education and its operational frameworks were developed and published [17-19].

This work, therefore, hypothesizes that heterogeneity in types and uses of innovations and technologies would limit their validity and reliability to achieve educational outcomes or competencies with optimal outcomes except that they are used based on guiding principles that are premised on sound educational theories as well as empirical; the evidence is used to form the basis of judgment, and strategies for use and their pedagogical approaches. Furthermore, this work proposes that to optimize the use of an innovation or EdTech to support higher education or medical education, there are three key areas of consideration which include curriculum, pedagogy, and assessment.

Technical Report

**Method**

This section presents a 10-step approach to digitalizing the ASIC framework, starting with defining a clear problem in need of a solution to creating a product with proof of concepts for practical applications and navigating through technical and legal issues. While it is important to state that these steps were not necessarily followed strictly sequentially, it is important to note that the 10 steps have been clearly highlighted in a way that they could form a practical guide for an educator or an innovator seeking information on steps to a methodical approach or producing an educational innovation. They also serve to present evidence that the ASIC framework has been developed with adequate considerations for the creative flow of thought, application of sound medical theories and principles, and project management knowledge and skills (Figure *1*). The 10-step approach is highlighted as follows:



**FIGURE 1: ASIC framework adapted from the original work on ASIC.**

An illustration showing a relationship between the use of technologies and innovations for educational purposes in a specified context such as the classroom or simulation facility in connection with the outcomes in the domains of knowledge skills and attitude. It also represents the functional and operational relationship between technologies/innovations, teaching or training and program outcomes in relation to competencies as milestones based on program design [17,18].

ASIC: Adaptation, Standardization, Integration, and Compliance; K: Knowledge; S: Skill; A: Attitude.

*Defining a Problem in Need of Intervention*

The problem statement for the current work could be stated as follows: Heterogeneities in EdTech and innovation use and impact are resultant of a lack of established standard practices and poor adherence to pedogeological practices and relevant learning theories while deploying educational technology and innovations. The initial idea to have a framework, standard tool, guiding theory, or a set of principles for optimizing the use of innovations and technologies for medical education was identified through experiences, multi-institutional, multinational, and action project activities [20-22]. A critical appraisal of EdTech use in a medical school that was highly innovative and tech-driven yielded a number of considerations that were further crystallized into key tenets. A reflective practice and critical analysis of how the efforts succeeded helped to analyze the purpose of the key tenets. Further critical thinking and analysis helped to design a hypothetical educational ecosystem and connect the tenets with actual elements of the ecosystem, through an iterative process that helped design a sample reference framework model with working principles that could be applied to diverse educational systems. The four tenets include Adaptation, Standardization, Integration, and Compliance. From these, the acronym ASIC was made, and the emergent framework was named the ASIC framework for optimizing EdTech and educational innovations.

Following the successful publication of the original idea as a scholarly article with quality peer review, a tool for operationalizing the framework so that educators and academic leaders can effectively apply the principles of the ASIC framework was developed and published as the ASIC matrix. Continual use of the original matrix provided further insights into a need to further simplify the application of the ASIC principles for medical educators whose interest revolves around certain core aspects of medical or higher education which were defined to include Curriculum (C), pedagogy (P), and assessment (A) in line with the identified pillars of medical education which are relevant to teaching- and training-related practices.

Consequently, the ASIC framework operational matrix that addressed innovation and EdTech’s optimization with emphasis on curriculum, pedagogy, and assessment was designed and published as the ASIC framework CPA operational matrix. This ASIC framework CPA operational matrix was successfully digitized for ease of access, use, and appraisal of educational innovations and technologies. It also accrues features that validate the use of the digital tool.

*Establishing a Sound Theoretically Correct and Pedagogically Sound Model*

It was important to ensure that the model aligned with relevant learning theories and pedagogical principles for teaching. Here are selected specific instances (see Table *1*).

**TABLE 1: Steps for establishing a sound theoretically correct and pedagogically sound model.**

ASIC: Adaptation, Standardization, Integration, and Compliance; EdTech: educational technologies.

|  |  |  |
| --- | --- | --- |
|  | **Key considerations** | **Additional information** |
| a | Adult learning theory [23,24] | ASIC was designed with the premise that the beneficiaries of EdTech use for medical and higher education are adults; it also considers a learner-centered approach. |
| b | Cognitive load theory [25,26] | ASIC design has a premise that EdTech use should minimize extraneous load and optimize intrinsic load while managing germane load effectively. |
| c | Miller’s pyramid [27,28] | ASIC framework requires that the learning outcomes should be clearly defined and measurable in line with the EdTech and innovation[s] used. |
| d | Kolb’s learning cycle [29,30] | The use of an EdTech is aligned with Kolb’s cycle such that it could contribute to the process of achieving a holistic learning experience, e.g. an educator could decide whether an EdTech served the purpose of experimentation or conceptualization. |
| e | Bloom’s pyramid [31,32] | There is a premise that the use of an EdTech or innovations should be aligned with an identified level of Bloom’s pyramid. For example, an educator should determine whether a learner who uses an interactive 3D anatomy digital atlas needs to identify the already dissected anatomic structures or to explore, self-dissect, identify, and describe. |
| Visual, auditory,  Considerations for multiple modality nature of educational resources: There were considerations for the use  reading/textual, and  f of resources that provide knowledge (cognitive), or that help to impart skills (psychomotor) or attitude kinesthetic (VARK)  (affective) in the forms of visual, auditory, reading/textual, and kinesthetic (VARK) modalities [33,34].  modalities [33,34] | | |

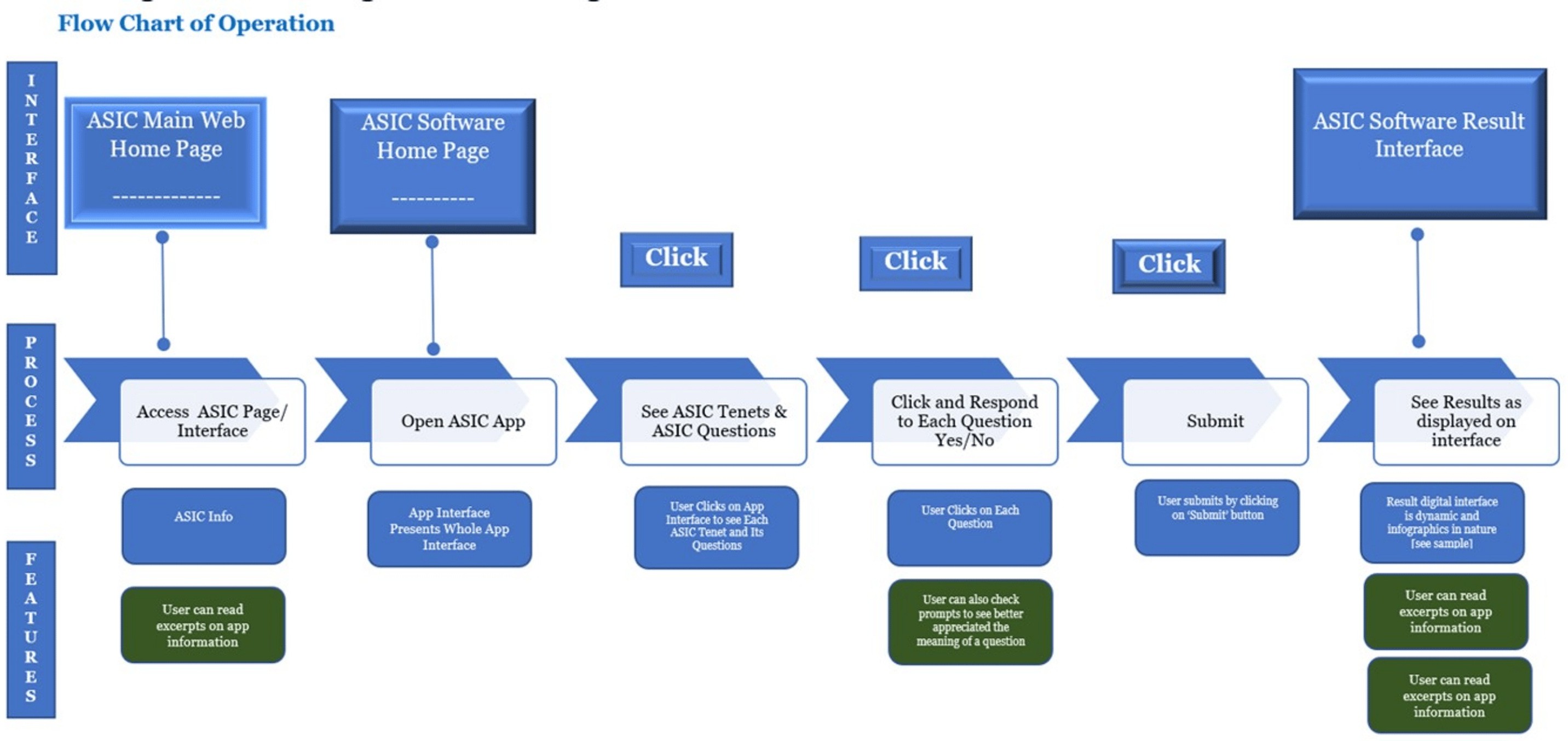
*Generating Practical Evidence From Practice*

After putting together ASIC as a framework, evidence was obtained from actual practice in different contexts of subjects, institutions, and students. Publishing the framework first, the first operational matrix and the alternative operational matrix in peer-reviewed articles provided major opportunities for critique from educators and academic leaders. Teaching and communicating the ASIC concepts in professional meetings, institutional training-the-trainers programs, and other fora provided quality feedback for improvement.

There was also published evidence of adoption in other climes.

*Designing an Algorithm Flow*

An algorithm flow for the digital operation of ASIC was developed (Figure *2*). The algorithm was communicated to a team of assembled designers and programmers; the initial algorithm flow was tested and iteratively remodified until a suitable flow was obtained. The adopted model was the basis for the digitalized version of the ASIC operational matrix.



**FIGURE 2: Summary of algorithm flow of actions and functions for the start to submission.**

The process includes the following: Access Interface -> Open App -> See ASIC Tenets & ASIC Questions -> Click and Respond to Each Question Yes/No --> Submit -> See Results as displayed on the interface.

ASIC: Adaptation, Standardization, Integration, and Compliance.

*Writing Codes and Creating a Suitable Platform*

First, a suitable algorithm was designed, then, clear specifications for cloud and web-based support platforms were defined. Key considerations included operational effectiveness, functionality, user interface accessibility, security protocols for both users and applications, data protection measures, interactivity, and access management. Following a proper understanding of the major considerations, the codes for the digital framework were written. The process was iterative as the developer team met iteratively with the ASIC inventor to test the product at every stage. A workflow for a test-analyze-validate-and-progress model was adopted.

*Producing a Proof of Concept*

Following the collection of coding and testing, ASIC was made available to the developer and the expert teams who consistently interacted with the platform for over three months. During this period of interaction, bugs were identified and fixed, and web esthetics and interfacility were considered and addressed as well. Several modifications were made to ensure an optimally technically efficient ASIC product with quality attributes for access, security, reliability, interactivity, and user-friendliness in terms of attractive interface esthetics.

*Quality Assurance and Validation*

For the purpose of quality assurance: The ASIC inventor ran multiple tests to test operations and output and to check the product’s efficiency. An expert and senior educator was consulted for assessment, and also ASIC was made available to the public for use. Useful feedback was collected and applied.

*Reflective Practice as Tool for Continuous Refining of Idea*

Right from the initial release of the ASIC digital product, there has been regular analysis of feedback; much more importantly, a reflective practice based on experience, reflection, and purposeful action (ERA) has been continually applied to ASIC to optimize the technical capacities of ASIC but also very importantly, the ease of use and applications to enhance user’s productivity and efficiency in relevant contexts. This is an ever-continuous process.

*Product Improvement Through Educational Research*

There is a solid plan in place for product improvement through educational research. ASIC is available for educational research purposes and concession is made to researchers to afford them the opportunity to conduct research on product sustainability and impacts. Also, there is a standard ASIC Research Instrument that can be used by researchers to conduct research in their immediate educational context which can be published eventually. On the other hand, researchers can use the instrument to collect data as members of a global ASIC EdTech consortium toward advancing medical and higher education. This questionnaire

instrument is made available at no cost to researchers.

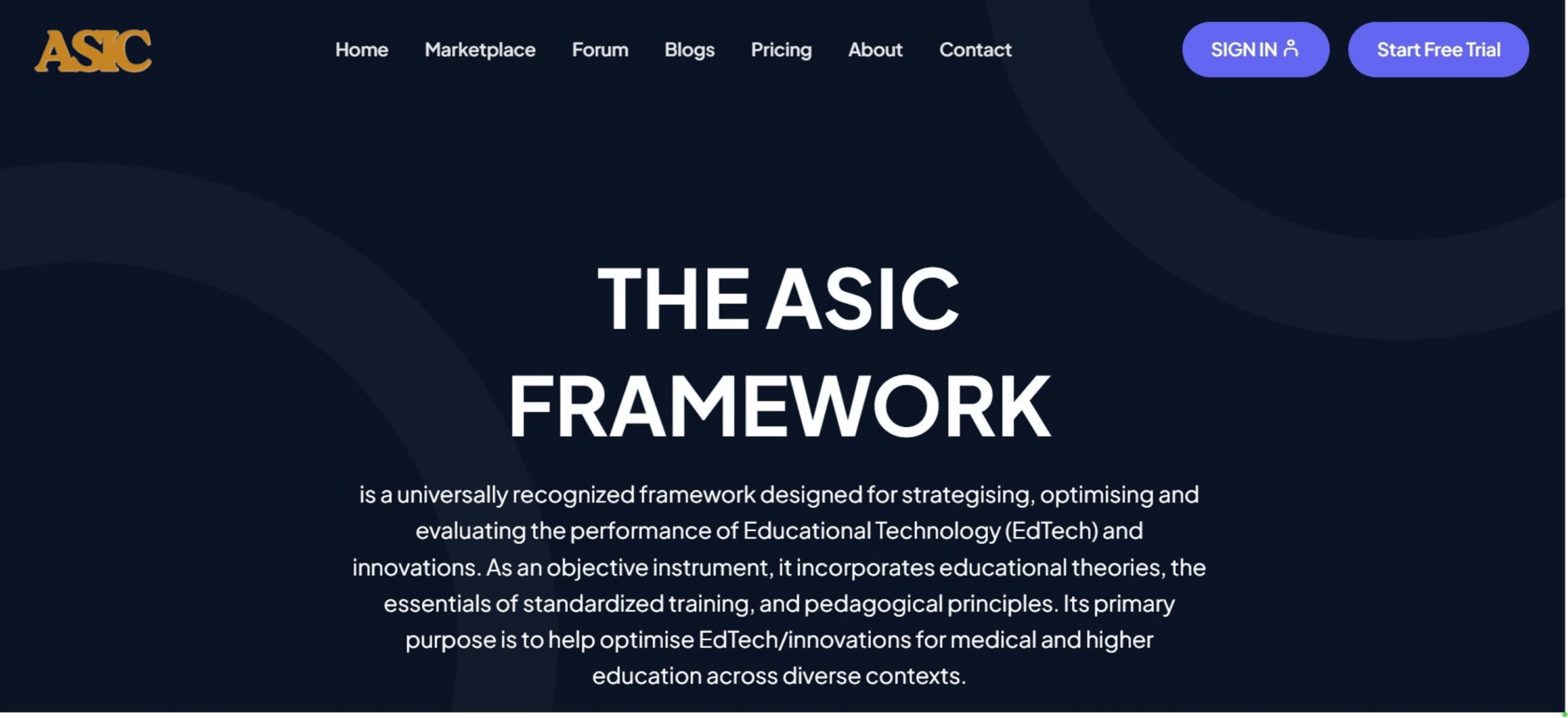
*Legal and Technical Conditions: Continuous Evaluation of Product*

The ASIC (EdTech) operational matrix is published and the inventor and author have copyright to its original forms in line with the guidelines and policies of the journals in which it was originally published. The digitalized version, being a digital product, is currently being processed for a patent right. This ensures intellectual protection and protects from adulteration that could be scientifically and technically counter- productive to the optimization of the product. It also serves as a good example for educators who are equally innovators on a need to optimize their original innovations or inventions and put in place appropriate legal and intellectual protections.

**Result**

*The Digital ASIC Framework*

The digital ASIC framework has all the elements of the originally developed and published ASIC framework, which emphasizes Adaptation, Standardization, Integration, and Compliance in three key areas, namely, curriculum, pedagogy, and assessment. While the ASIC tenets emphasize the key areas of consideration to address when deploying EdTech and innovations, the CPA emphasizes the core domains that require attention. The digital framework and its operational matrix allow the ASIC tenets to address the CPA domains in line with each tenet. For example, the operational matrix addresses the place of adaptation in the place of curriculum, pedagogy as well as assessment. The digital framework is now available as an App that requires the user to answer 12 questions in all with three CPA (curriculum, pedagogy, and assessment) questions under each ASIC tenet (Figure *3*) [35].



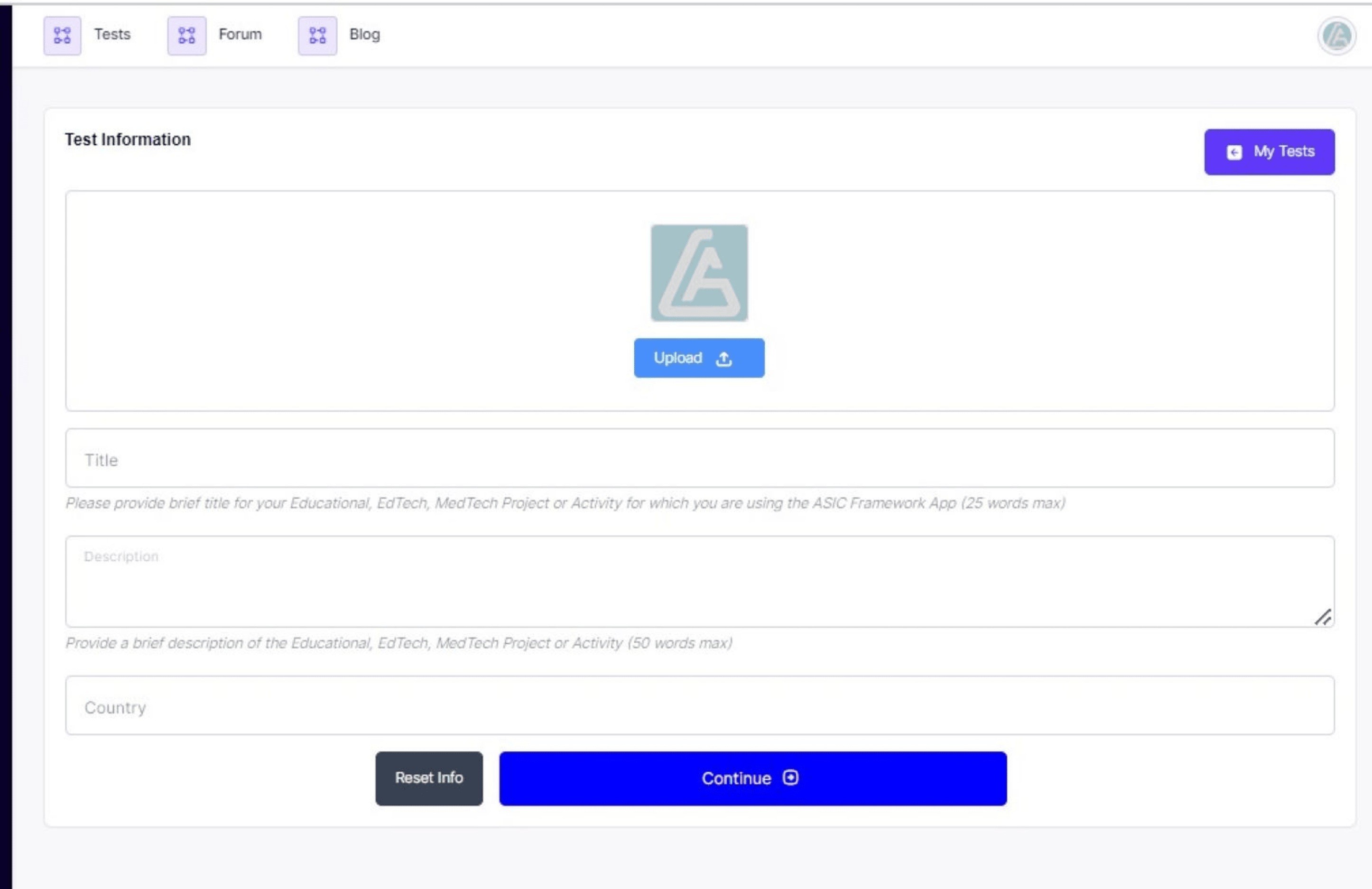
**FIGURE 3: ASIC webpage interface,** [**https://asicedtech.com/**](https://asicedtech.com/)**.**

Clicking the named buttons and icons takes the user to each feature of the ASIC EdTech framework features. The sign-in link takes the user to the dashboard that has the ASIC EdTech app with a set of instructions to follow.

ASIC: Adaptation, Standardization, Integration, and Compliance; EdTech: educational technologies.

*Digital ASIC Framework: A Description*

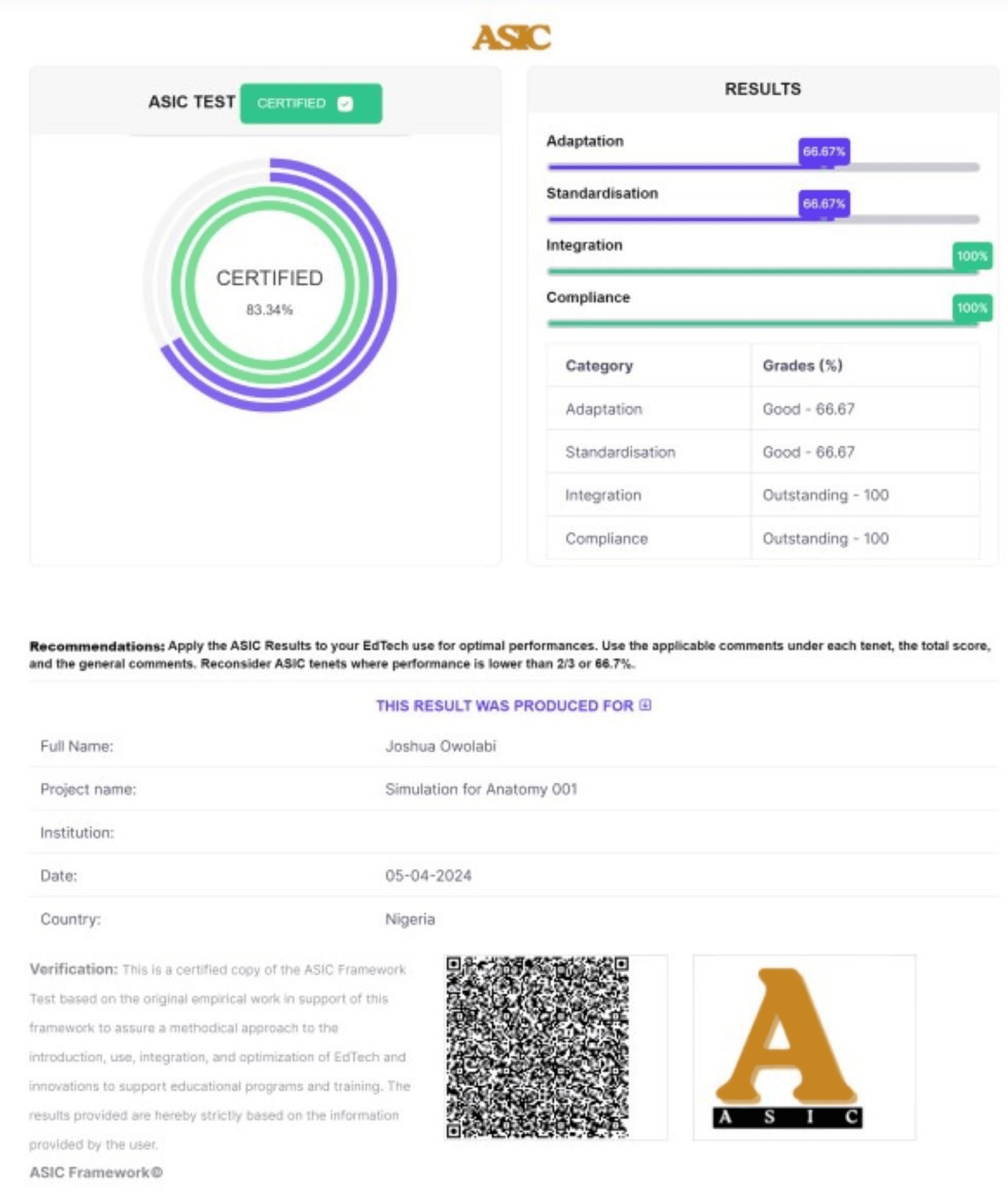
The digital ASIC framework is accessed through the ASIC EdTech webpage or as an Android or IOS App (Figure *3*). Once accessed or installed in the latter instance, the ASIC Digital interface requires the user to enter specific information about the EdTech of interest (Figure *4*). A logo can also be provided. The interface thereafter requires the user to answer Yes/No to three CPA (curriculum, pedagogy, and assessment) questions under each ASIC (Adaptation, Standardization, Integration, and Compliance) tenet. Upon completion and submission, the result is generated with unique features for identity including the ASIC scores and the performance indicators both in numerical values as percentages and in graphical format. The total sum of impact value is also provided. The result is released with a barcode feature that can always be used to access the results and verify their authenticity (Figure *5*). The result is also archived under the user's account and it is perpetually accessible. When downloading the unique result, the ASIC interpretation rubric is also downloadable for reference.



**FIGURE 4: ASIC EdTech test interface.**

This interface allows the user to enter basic information about the technology or information of interest. This information is saved and used to identify the results of the test subsequently.

ASIC: Adaptation, Standardization, Integration, and Compliance; EdTech: educational technologies.



**FIGURE 5: Digital results features.**

The result's interface has a dynamic interface with illustrations with a pictogram of test-indicated performances and a barcode.

*Explaining ASIC Working Principles*

ASIC framework has four tenets namely Adaptation, Standardization, Integration, and Compliance. In terms of working principles, the ASIC operational matrix considers the application of the four tenets to three core areas of an educational experience, namely curriculum, pedagogy, and assessment. This is of key significance as the inability to operationalize the ASIC framework would either create ambiguity and subjectivity or make it impractical for accurate application. Application of ASIC to curriculum helps to address the validity and reliability of the use of EdTech and innovation for an educational experience. It also helps to determine whether the EdTech and innovation as used could provide an appropriate and adequate educational experience based on curricular requirements and whether a plan for consistent and accurate repeatability has been considered. Pedagogy also helps with the validity of an educational experience by assuring educational methods in line with relevant theories and principles such as adult learning

theories. Assessment helps to measure the impact value of an EdTech/innovation on the learning experience as a measure of performance. The place of the CPA areas of ASIC applications can be highlighted as follows (see Table *2*).

|  |  |  |
| --- | --- | --- |
|  | **CPA**  **domains** | **ASIC applications** |
| a | Curriculum | This considers the appropriateness of an EdTech/innovation to accomplish learning outcomes and ultimately program competencies-based program design and specific indicative content in the curriculum. |
| b | Pedagogy | This considers the educational value of the EdTech/innovation based on the applicable learning theories and pedagogical principles. It considers whether an EdTech/innovation can adequately help to achieve the objectives or outcomes of learning sessions in one or more of the cognitive, psychomotor, and affected domains. |
| c | Assessment | This considers whether the assessment exercises based on the use of an EdTech or innovation could meet assessment validity and reliability criteria in alignment with competencies that are required to be acquired ultimately. |

*Practical Use of ASIC Framework for Individuals, Groups, and Administrators*

**TABLE 2: ASIC applications to CPA.**

CPA: curriculum, pedagogy, and assessment; ASIC: Adaptation, Standardization, Integration, and Compliance; EdTech: educational technologies.

ASIC framework tool and its operational matrix can be used by individual educators, groups of educators such as those in a department or program faculty, or by administrators and organizational or institutional levels. Below are descriptions of specific contexts or settings and the basic steps included in using ASIC to assure innovation/EdTech optimization:

ASIC for individual use: When used by an individual educator, ASIC could help to make the choice of the most appropriate innovation or EdTech to acquire, how to systematically integrate the EdTech/innovation into a course or program, and how to optimize the use of the EdTech, then validly and reliably measure the impact through assessments of students and evaluation of the experience. Table *3* has the key considerations.

|  |  |  |
| --- | --- | --- |
|  | **Key considerations** | **Additional information** |
| 1. | Identify the innovation or EdTech of interest | a. This might be made through a needs assessment |
|  |  | b. It could also be a response to an identified problem that technology could address |
|  |  | c. Or a response to an institutional agenda to use technology or a trend in the educational and professional arena |
| 2. | Define clearly the context of the use | a. Determine how specifically the EdTech adds value to students’ educational experience in the knowledge, skill, and attitude domain |
|  |  | b. Define the pedagogical framework that would guide the use of Edtech/innovation. |
|  |  | c. Determine a practical approach to its integration into the structural and functional aspect of your educational practice or teaching by considering curricular schedules, physical or technical space, and virtual environments - whichever might be applicable. |
| 3. | Envision its prospects to add value to your overall educational ecosystem | a. Align the use of innovation/EdTech with curriculum requirements and reflect how its use to achieve these could be justified. |
| 4. | Apply ASIC and use the result for optimization | a. Answer each ASIC question. |
|  |  | b. Use the prompt in each case to guide proper reflection. |
|  |  | c. Document your supporting statements following reflections on each question. |
|  |  | d. Use the document with all supporting statements as the guiding template to assure adaptation, standardization, integration, and compliance. |
| 5. | Deploy, and measure performance by outcome, acceptability by feedback. | a. Keep to the set standard following the ASIC exercise in the previous step. |
|  |  | b. Document experience in relation to the standard under each tenet. |
|  |  | c. Use the experience versus pre-set standard to a reflective practice, to generate an action plan for sustainability and improvements. |
| 6. | Improve the approach to deployment and re-deploy | a. Evaluate EdTech performance following deployment, and apply valid evaluation results. |
| 7. Keep optimizing a. Apply evidence to advance practices and keep iterating. | | |

ASIC for group use: A group of faculty members such as a member of a department or faculty members in a program can collaboratively use ASIC to guide EdTech deployment, and measure impacts and plan further improvement. In this instance, each faculty member or stakeholder can complete the ASIC Instrument, then averages of responses are computed and the interpretations of the verdicts are based on the ASIC rubrics.

**TABLE 3: Key steps and considerations on how to use the ASIC framework by individuals.**

ASIC: Adaptation, Standardization, Integration, and Compliance; EdTech: educational technologies.

The alternative approach would be that the group of educators deliberate and arrive at a consensus on each ASIC Instrument item. Then, the consensus is interpreted using the rubric and this final outcome being a reflection of the collective verdict would guide decisions on EdTech use and optimization. The benefit of the latter approach is that the ASIC Instrument can be used iteratively. When an ASIC tenet scores zero, deliberations can help to reflect on the existing circumstances, and a decision can be made to restructure the same to favor a positive consideration such that the process helps to also determine the change that is required to favor the use of the EdTech/innovation of interest (see Table *4*).

|  |  |  |
| --- | --- | --- |
|  | **Key considerations** | **Additional information** |
| 1 | Define an area of educational experience to be enhanced using innovations/EdTech | a. Define the context of use properly. |
| 2 | Identify an EdTech/innovation to adopt | a. Determine the most appropriate EdTech or innovation, especially based on need, feasibility, and educational value. |
| 3 | Design the process of introduction into the ecosystem; consider the key 4Ps namely purpose, people, process, and product/outcome. | a. Purpose - the need to use the technology should be clearly justified. |
|  |  | b. People - the individuals that would be involved in the EdTech/innovation- enabled change and their roles should be clearly defined and assigned. |
|  |  | c. Process - the process of change, as a roadmap, should be presented. |
|  |  | d. Product/outcome - the envisioned outcome should be stated and well aligned with curricular indicative contents, program design, and professional competence to be acquired. |
| 4 | Apply ASIC tenets; obtain an initial result and use it to optimize deployment. | a. Answer ASIC questions, preferably as a group. |
|  |  | b. Apply prompts to clarify verdicts leading to the answer. |
|  |  | c. Generate a document of 1-3 key considerations on which a favorable answer to each tenet was premised. |
|  |  | d. Carefully curate the document (generated under 4c) into a document that informs the practice that would guide the institutional and professional use of EdTech and innovation. |
| 5 | Deploy, and measure performance by outcome, acceptability by feedback. | a. Use valid and reliable outcomes to measure impact; use feedback tools to measure acceptability. |
| 6 | Analyze performance and feedback data for evidence on methods and results; re-deploy | a. Obtain evidence by properly analyzing outcomes and feedback; derive inference. |
| 7 | Keep optimizing | a. Keep improving on the methods of use. |

ASIC for institutional and professional use: In the professional circle, such as the community of practice, ASIC can help to come up with standard practices or recommendations regarding the use of an innovation or EdTech especially when such is new or when an existing EdTech or innovation is being adapted or repurposed. ASIC could help in determining the educational value of such EdTech/innovation and their potential impact. Since the exercise in this instance would normally include a group of experts, the reflective processes that lead to answering ASIC questions and coming up with positive answers would equally lead to generating statements of guidelines on standard practice (see Table *5*).

**TABLE 4: Key steps and considerations on how to use the ASIC framework by a team or group.**

ASIC: Adaptation, Standardization, Integration, and Compliance; EdTech: educational technologies.

|  |  |  |
| --- | --- | --- |
|  | **Key considerations** | **Additional information** |
| 1 | Define the role of EdTech and innovations for educational purposes | a. It is important to clearly define what problem could be solved with an innovation or EdTech or what additional educational value the EdTech could contribute. |
| 2 | Characterize resources that align with educational cultures and drive change; identify EdTech and innovations | a. Based on needs assessment, context, and practical applications, identify the most appropriate EdTech or innovation of choice. |
| 3 | Apply design thinking to determine the key areas of EdTech use; establish KPIs | a. It is good to adopt a model for the design-thinking process - the IDEO model highlights steps that include Empathizing, Ideating, Concepting, Prototyping, and Implementing. What this does is to establish a roadmap for the innovative change process. |
|  |  | b. Key performance indicator (KPI) helps to define the specific functions that EdTech and innovation should perform in any or all the cognitive (knowledge), psychomotor (skills), and affective (attitude) domains to make it work its use and justify resource investment that would be required. |
| 4 | Apply ASIC tool with emphasis on tenets; consider the role of the 4Ps (purpose, people, process, product/outcome) | a. Answer ASIC questions, preferably as a group. |
|  |  | b. Apply prompts to clarify verdicts leading to the answer. |
|  |  | c. Generate a document of 1-3 key considerations on which a favorable answer to each tenet was premised. |
|  |  | d. Carefully curate the document (generated under 4c) into a document that informs the practice that would guide the institutional and professional use of EdTech and innovation. |
| 5 | Initiate change process, define milestones, measure impacts, and obtain feedback | a. Apply a suitable implementation model or strategy for the change process. |
| 6 | Analyze data and feedback; align inferences with the KPIs | a. Data on EdTech performances should be properly analyzed for evidence of impact and justification for continuous use. |
| 7 | Keep optimizing | a. Protocols should be updated continuously, and methods should be improved upon. |

*ASIC and the Educational Ecosystem*

**TABLE 5: Key steps and considerations on how to use the ASIC framework by institutions and professional bodies.**

ASIC: Adaptation, Standardization, Integration, and Compliance; EdTech: educational technologies.

An educational ecosystem may be described as a system of structural and functional domains or systems interconnected by an operational network and governed by established principles and rules toward achieving an educational outcome. In a typical educational ecosystem, the structural components include physical infrastructures and the hardware that help facilitate educational experiences. This might include the physical learning spaces such as classes, laboratories, and simulation rooms; others might include machines and hardware such as computer devices, media, and specific-purpose machines such as the MRI machine in the hospital, microscopes in the laboratory, and high-fidelity mannequins in the simulation laboratories.

The functional components of the ecosystem include activities that enable the use of these infrastructures and resources for facilitating sessions in classrooms, clinics, laboratories, workshops, or open fields, and other contexts of training or practice. With technologies and innovations, the networks that interconnect the structural and functional aspects of the ecosystems could be facilitated by the internet connection, or actual structural and electrical connections, aided or operated by humans or other machines. In the educational ecosystem, humans are their ultimate operators and activities are guided and aided by theories, rules, principles, and standard practices often provided as policies and guidelines.

To operationalize ASIC in an educational ecosystem, the culture of the system is of key importance. Innovations and technologies could significantly shape the culture of an educational system. It is important to carefully assess the current prevalent culture, and define the desired change to the current culture as well

as the process for leading the desired change with innovations and technologies playing key roles. This is why the 4Ps become of key consideration. While ASIC could help individual members of the educational system to develop and optimize technologies and innovation, the entire organization could also use ASIC for leading change with innovations in accordance with the steps indicated for ASIC For Institutional and Professional Use as indicated in the previous section.

The basics of the ASIC algorithm include the features listed in Table *6*.

**TABLE 6: Basics of the ASIC algorithm and their features.**

ASIC: Adaptation, Standardization, Integration, and Compliance; EdTech: educational technologies.

|  |  |  |
| --- | --- | --- |
|  | **Basics of the ASIC algorithm** | **Features** |
| 1 | Interface | The interface has a measuring scale that shows scores of an EdTech ASCI value; there is also a small window that shows the actual score as a percentage. There is a parallel bar that equally presents the score on a scale bar with colors showing the zone of performance with red being on the far left and the worst performance, and green being on the far right and the highest. |
| 2 | Measurement parameters | Each ASIC tenet has three considerations that are to be answered Yes/No. Each Yes response is a score of 1 out of the possible total of 12 or an equivalent percentage. See the questions on the next page. |
| 3 | Operational principles | To answer each question on the software/app, the user will have to click on the ASIC question and click the applicable option out of the Yes/No (no neutral response is allowed). Each Yes response accounts for 1 and a No gives a score of 0. |
| The prompts include strategic questions that are aimed at stimulating ASIC users toward understanding  4 Prompts  the significance of the questions, quality reflections, and providing the most appropriate responses. | | |

Features of the software and the operational interface are presented in Table *7*.

|  |  |  |
| --- | --- | --- |
|  | **Main parts of the software and the operational interface** | **Features** |
| 1 | ASIC web page - landing page | The landing page has concise information that introduces ASIC as an idea and provides the meaning of its four tenets including A - Adaptation, S - Standardization, I - Integration, and C - Compliance. The Landing page has a link to the ASIC dashboard for registrations at first and subsequently log-in. The Landing page further has other very helpful information such as the frequently asked questions and links to various ASIC webpage parts such as the forum. It also has a set of frequently asked questions. |
| 2 | Dashboard | The dashboard has the link to the ASIC test software. It also has other product information and supporting links including forum, subscription, and security. |
| 3 | Access to the software | Access to the functional ASIC software is through the test link on the dashboards. |
| 4 | Operational interface | This interface registers a test; it has provisions for a logo (optional) and the test title. |
| 5 | Software operation | The software is operated by answering the questions with either Yes or No. Prompts are available for further liberation and guidance. |
| 6 | Digital result features | Upon submission, the result is downloaded automatically. A link to keep a permanent copy of the result is also automatically created. Features of a basic result include ASIC scores for a test in all sections and the overall average score and the ASIC verdict. The subscription-level results interface has a dynamic interface with illustrations with a pictogram of test-indicated performances and a barcode. |
| 7 | Interpretation rubrics | The rubric with a comprehensive guide for interpreting the result is also automatically downloaded as a PDF (see Table 8). |
| Other  8 The dashboard has links to offerings such as ASIC courses. considerations | | |

Features of the ASIC framework results interpretation rubric are presented in Table *8* while the interpretations (Adaptation, Standardization, Integration, and Compliance) are provided in Table *9*.

**TABLE 7: Main parts of the software and the operational interface and its features.**

ASIC: Adaptation, Standardization, Integration, and Compliance; EdTech: educational technologies.

**TABLE 8: ASIC framework results interpretation rubric.**

ASIC: Adaptation, Standardization, Integration, and Compliance; EdTech: educational technologies.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | **Poor <60** | **Good 61-70** | **Very good 71-80** | **Excellent 81-90** | **Outstanding 91-100** | **General comment** |
|  | Does not sufficiently | Partially satisfies at | Sufficiently satisfies at least one adaptation- related component of combined CPA requirements |  |  | A less than 2/3 score under Adaptation requires consideration to sufficiently meet the  >2/3 requirement |
|  | satisfy at least one | least one | Sufficiently satisfies at least | Sufficiently satisfies three or |
| Adaptation | adaptation-related  component of | adaptation-related  component of | two adaptation-related  components of combined | more adaptation-related  components of combined |
|  | combined CPA | combined CPA | CPA requirements | CPA requirements |
|  | requirements | requirements |  |  |
|  | Does not sufficiently | Partially satisfies at | Sufficiently satisfies at |  |  | A less than 2/3 score under standardization requires consideration to sufficiently meet the  >2/3 requirement |
|  | satisfy at least one | least one | least one | Sufficiently satisfies at least | Sufficiently satisfies three or |
| Standardization | standardization-related  component of | standardization-  related component | standardization-related  component of | two standardization-related  components of combined | more standardization-related  components of combined |
|  | combined CPA | of combined CPA | combined CPA | CPA requirements | CPA requirements |
|  | requirements | requirements | requirements |  |  |
|  | Does not sufficiently | Partially satisfies at | Sufficiently satisfies at least one integration- related component of combined CPA requirements |  |  | A less than 2/3 score under integration requires consideration to sufficiently meet the  >2/3 requirement |
|  | satisfy at least one | least one | Sufficiently satisfies at least | Sufficiently satisfies three or |
| Integration | integration-related  component of | integration-related  component of | two integration-related  components of combined | more integration-related  components of combined |
|  | combined CPA | combined CPA | CPA requirements | CPA requirements |
|  | requirements | requirements |  |  |
|  | Does not sufficiently | Partially satisfies at | Sufficiently satisfies at least one compliance- related component of combined CPA requirements |  |  | A less than 2/3 score under compliance requires consideration to sufficiently meet the  >2/3 requirement |
|  | satisfy at least one | least one | Sufficiently satisfies at least | Sufficiently satisfies three or |
| Compliance | compliance-related  component of | compliance-related  component of | two compliance-related  components of combined | more compliance-related  components of combined |
|  | combined CPA | combined CPA | CPA requirements | CPA requirements |
|  | requirements | requirements |  |  |
|  |  | Consider all ASIC | Consider ASIC tenets with low ASIC values to improve on EdTech/innovations’ performance requirements | Consolidate ASIC tenet values by improving performance in concerned categories to fully optimize EdTech/innovations’ performance | Sustain ASIC tenets values and translate value to the actual context of use and practice for optimal EdTech/innovations’ performance |  |
|  | Consider all ASIC | tenets to improve on |  |
| Total | tenets to meet | EdTech/innovations’ | ASIC |
|  | minimum requirements | performance |  |
|  |  | requirements |  |

|  |  |
| --- | --- |
| **A** | **S** |
| **Adaptation** | **Standardization** |
| Adaptation implies that innovations and educational technologies or EdTech should be suitably adapted to the learning ecosystem, program design, and institutional system, for optimal performance and best outcomes. | Standardization involves determining clearly the purpose that innovations and technologies serve, the objectives they meet; and supporting their uses with evidence for best and standard practices. It also involves the use of innovations and EdTech in alignment with sound educational and learning principles. |
| **I** | **C** |
| **Integration** | **Compliance** |
| Integration involves creating a place for the use of educational innovations and technology within the immediate teaching or training ecosystem, and aligning its use with other components of the educational system for optimal performance. Key considerations include system thinking and synergy. | Compliance emphasizes alignment with institutional policies, regulations, and practices as well as relevant regulatory requirements (if applicable). Evidence of compliance with institutional standards, program requirements, and regulations of relevant bodies should be addressed. |
| Total score = ASIC value | |

Discussion

**TABLE 9: Interpretation of ASIC tenets.**

ASIC: Adaptation, Standardization, Integration, and Compliance; EdTech: educational technologies.

**Significance of the digitized ASIC Framework CPA operational matrix**

The rapid nature of educational changes as driven by technology and innovations, coupled with a lack of requisite knowledge of educational principles that apply to EdTech and innovations coupled with a lack of practical skills to apply them has created significant heterogeneities in the methods, manners, and strategies for leading change with innovations as well as skillful and effective deployment of EdTech and innovations for optimal educational experiences. Heterogeneity, therefore, has emerged as a major problem with Edtech for educational activities. There are clear cases of heterogeneities in the types of EdTech that are available for similar educational purposes, i.e. validating the vast number of options to choose from when seeking to use tech and innovations for educational purposes. Interestingly, the eventual choices are not often premised on empirical evidence or educational values or based on guiding principles but on sentiments that bother expert opinions, availability of funds, and institutional agenda. Where existing theories and principles can be applied to guide EdTech use, many experts lack the requisite knowledge of such fundamentals or the skills and capacity to apply them in their judgments of choice and methods of use. Another source of heterogeneities is the indiscriminate use of technologies to achieve pedagogical activities that are somewhat traditional or well established without recourse to the use of evidence and application of principles to ensure the validity and reliably of the innovations or EdTech to achieve similar or better outcomes with the EdTech or innovations relative to the established principles.

Often, short-term gains and immediate but arguably unsustainable results are considered as the main sources of motivation.

The ASIC framework was initially developed and has four key tenets, namely Adaptation, Standardization, Integration, and Compliance. These key tenets were organized into a functional framework, from which an algorithm was developed to optimize it for determining the validity and reliability of an

educational innovation or technology to optimally provide an educational experience with emphasis on the curriculum, pedagogy, and assessment. Furthermore, the ASIC framework was matrices that could help in guiding an educator to creatively and quantitatively determine the potential impact of an EdTech or innovation within an educational ecosystem. This algorithm has been effectively digitalized. It is

now available as a web-hosted software with alternative versions in the form of apps on IOS and Windows platforms. This article presents the experience as a whole. It could provide quality guidance to other educational innovators. It also serves the purpose of guiding educators on how best to optimize

their innovations and EdTech for optimal learning experiences for their learners and trainees. The fact that several types of technologies and innovations can be suitably adapted and integrated into a medical or health education program using the ASIC framework is important. ASIC can guide strategic advancements with technologies and innovations in medical education with diverse products including Artificial Intelligence (AI), noting that the value of AI in medical education and care is now being seriously explored [36,37].

**The problem of heterogeneities in relation to EdTech and innovations for medical and ASIC-derived solutions**

There is no doubt that with the increase in advancements in technology and innovation, there will be several new types of innovations or technologies that can be used for medical education and, by extension, higher education in general. The implication of this is that there will be more varieties of tech innovations from which educators are required to choose. With more choices available, the reality of using a wide range of innovative approaches and technologies for similar purposes in different contexts of medical education will also come to light. An abundance of choice in terms of the available innovations or tech might not be a problem in itself, but heterogeneity would definitely result if standards are not set with clear guiding principles. Understandably, not all educators have extensive expertise in the primary domains of medical education in addition to their scientific and clinical competencies. The implication of this reality is that the

requisite knowledge and competence to make informed decisions about the most appropriate technology and innovations in relation to the pedagogical framework to use would vary from place to place.

This is therefore why a case is being made for the use of a tested and standardized framework such as the ASIC. Not only is this framework premised on clearly stated educational theories and pedagogical principles, but it also has the versatility that supports its deployment in almost any context of medical education. It is also not cumbersome for educators to understand, especially in terms of its operational principles and applications. Clearly, digitizing this framework is also a way to democratize it and make it readily available to people in almost any part of the world. This is arguably one of the most educational frameworks with clearly listed pedagogical principles of the 21st century that address the use of innovation and technologies for medical education.

It is important to state that, unlike several other existing pedagogical frameworks that use descriptive attributes and guiding principles, the ASIC also has a quantitative approach to its use, a measure of impact, and an interpretation of the same. It is clearly a modern pedagogical framework that ranks favorably in terms of application with other popularly used pedagogical frameworks such as Kolb’s learning cycle, Argyris and Schon’s loops, Bloom’s taxonomy, and Miller’s pyramid. Nevertheless, credit should be given to the proponents of all relevant existing theories of learning and pedagogical frameworks, since they form the basis of scientific evidence to support the application and validity of the ASIC framework. It is highly recommended for individual educators, irrespective of their level of proficiency and experience, as it can objectively and consistently guide the decision-making processes regarding which type of educational technology and innovations to adopt, and more importantly, how to use such innovations or tech consistently and in line with learning theories and pedagogical principles. It is equally highly recommended to institutions and communities of practice. ASIC is arguably the only tool available currently to institutions and communities of practice to collaboratively make decisions on the best and most appropriate type of innovations and EdTech to adopt, and to justify the implementation plan by considering the four key tenets of adaptation, standardization, integration, and compliance. Furthermore, it emphasizes all the primary domains of learning, which include cognitive, psychomotor, and affective.

Also, it is important to further highlight that the problem of heterogeneity is not just about the diverse types of educational innovations and technologies that are available, but also the variations that exist in how they are used for similar purposes in different places and at different times. This aspect of heterogeneity regarding the use of EdTech and innovations can impact the qualities of validity and reliability, which are key attributes that define the assessment of learning and consequently provide justification for the acquisition of competencies. When an assessment cannot be adjudged to be valid and reliable following the use of technology and innovations, not just at the level of individual sessions or institutions but across professional settings, there arises a very important need to ensure that technologies and innovations are used in alignment with curriculum requirements, in line with sound learning theories and pedagogical principles, and validly and reliably in line with assessment principles.

ASIC remains a foremost framework that has been able to connect curriculum, pedagogy, and assessment, such that when similar technologies and innovations are used in different institutions or professional contexts, adherence to each tenet and attainment of positive indicators regarding the prospect of the innovation or EdTech in relevant domains of education and training would provide a justification for the use of technology for pedagogical purposes and justify ensuing results in assessments that have been valid and reliable. Therefore, in addition to guiding pedagogical approaches to using innovation and EdTech, ASIC also provides the basis for establishing the reliability and validity of assessments. Very importantly, this is done with a big picture of the entire program and its desired outcomes often defined by stated competencies.

**Promoting a culture of best practice**

One of the realities that has emerged as a result of gaps in the resources available to different institutions in various places is the significant potential gap in what constitutes standard practices across institutions that claim to train medical and health professionals. These professionals are expected to acquire similar levels of competencies at the end of their training. If the inequity that the disproportionate availability of resources to different institutions creates takes medical education back to a scenario similar to what existed prior to

Flexner’s reform of the early 1900s, the quality of medical education could vary significantly across institutions because there were no regulations that set the standard for best practices [38,39].

It is important to state that products of EdTech and innovation are required to provide technical guides and manuals, in addition to commercials that promote products often supported with the best available evidence to support the usefulness of their product with a bias for positive outcomes. To their credit, some of these producers also work with technology enthusiasts as well as a selected group of tech-competent medical educators. Nevertheless, it is also important to state that these relationships do not necessarily contribute to best practices at the institutional level. Instead, they help the producers optimize their products for the best user experiences and, subsequently, patronage. Therefore, it remains the responsibility of stakeholders in medical education to set standards regarding best practices that will guide the use of innovation and tech for medical education. This aligns with calls to address both educators’ tech and pedagogical competencies in order to properly use technologies and innovation for medical education [40].

Therefore, tech-competent medical educators have a responsibility to develop innovations and present innovative ideas that are products of not just their education but also their experience in practice. They blend, weave, distill, and curate evidence available in synthesized literature, then premise it on appropriate learning theories, pedagogical frameworks, and professional standards. This process, as described, is exactly what has yielded their significant work. It is therefore important to say that the ASIC framework, as an instrument, has significant value in contributing to promoting the culture of best practices in medical education and related communities of practice. It is also important to state that other existing pedagogical frameworks that have been listed or mentioned in this article were created at a certain point in time by competent educators, and they were continually applied and oftentimes refined to support educational activities. It would appear that the development of the ASIC framework also has a place in the timeline of the history of education as a tool that could address the current trend characterized by significant adoption and use of innovations and technologies for medical and higher education.

**Using ASIC to counter neo-Luddism**

The Luddite movement was responsible for a major campaign against the introduction of technology into the textile industry in Europe. From this event, attempts to resist the introduction of technology into a particular domain in the years that followed this historical event have been dubbed “Neo-Luddism”. The problem of neo-Luddism has often been touted as opposition to the use of technology for medical education in certain instances, and the actors involved are often dubbed neo-Luddites or anti-technology people [41- 44]. However, it is important to highlight that oftentimes people who resist technology or who are rather indifferent but unimpressed at the same time are often cautious about the negatively disruptive tendencies of certain technologies or poorly integrated innovative approaches. Even in the context of E-Health, three groups of non-adopters of E-Health technology have been identified as postponers, opponents, and critics, with the postponers and opponents groups including patients and families of patients [45]. Instances of failed attempts to deploy technology for educational purposes have reinforced resistant behavior in certain instances.

It is therefore important to understand that the use of evidence and a pedagogical framework to promote the use of technology, with an effort to not just promote standard practices but to continuously evaluate the performance of innovations and technology, could help address Neo-Luddism and provide convincing evidence to Neo-Luddites tech-ethicists. Tech ethicists are a group of people who insist that technologies are not used to break existing rules or disrupt existing orders in education. Noting that the introduction and integration of major technologies or innovations in an aspect of education could have a ripple effect, the use of a pedagogical framework can help to properly analyze the prospect and potential effects and to ensure that they are positive in terms of the impact that they might make in other aspects or domains of medical education. This argument, as presented here, is another strong indication of why the ASIC framework could be very significant to the advancement of modern medical education and should be given serious consideration by medical educators and other stakeholders, including academic leaders. People’s appreciation for the use of technologies in medicine currently varies significantly; with better education, exposure, and promotion of best practices, educators, professionals, and patients will increasingly appreciate the value of technologies [46].

**Importance of ASIC to stakeholders - educators, administrators, instructional designers, and academic leaders**

Much of the case that has been made for a need to standardize the use of EdTech and innovation has emphasized the importance of a standard framework for the job of medical educators. Administrators can also be better guided in making decisions on the choice of technologies to procure and in developing a plan to integrate technologies and innovation into the educational ecosystem while assuring value for the investment of resources and capital. For instructional designers, it is important for them to consider the specific innovation or technology that is being introduced and the impact of the same on the existing educational and infrastructure ecosystem. For example, it might be important to consider how a new technology, such as educational software, might be integrated into the existing learning management system with optimized access provided to the student. It might also be important to consider how other

resources that are already in existence will be functionally connected with a newly introduced technology or innovation such that they can run in sync for an optimal student experience. More than ever before, instructional designers have to consider not just the prospect of a particular edtech or innovation based on its performance, but also its synchronization with other components of the educational ecosystem.

Academic leaders are often required to ultimately make decisions regarding the innovations and technologies to be procured for their various programs or groups of students. There are times when they are required to consider cases or even arguments as presented by educators and other stakeholders. Using a framework such as the ASIC can guide all these stakeholders in working collaboratively to arrive at the best possible decisions by aligning paradigms, while at the same time considering the value of technologies and innovations based on their potential educational value or impact. For example, it is possible that a newly developed sophisticated technology might not be adding significant value to the program based on competencies that are required of students, even when the proponents are quite enthusiastic about its futuristic value. A practical framework can therefore help an academic leader to judge innovation and technology based on its value for money and return on investment, in addition to the actual educational value. Should there be an instance where an institution chooses to be a trailblazer by pushing the boundary of training by considering the use of a particular technology or innovation that is not already aligned with stated competencies to be acquired through a program, a standard framework such as the ASIC might still be able to help in carefully measuring what is to be committed to such effort while ensuring that it is not done at the expense of the already established and identified outcomes, which might be used by regulators and institutional standards to judge the success of the program? Academic leaders, especially, should also be aware that a major way to capitalize on the value that Edtech and innovation could add to the future of medical education is to start enshrining a healthy culture of technology into medical education right from now. Future doctors and health workers would practice in a tech-enriched environment where they need to be exposed adequately to technology during their training [19,47,48].

Conclusions

EdTech and innovations including educational devices and AI have significant roles in delivering medical education. The vast variety of EdTech and innovations available to educators as well as the different pedagogical approaches to using the EdTech and innovations have created a problem of heterogeneities that could undermine standardized educational experiences. There are currently no major tools and frameworks to guide EdTech deployment and optimization, hence the place of ASIC as a foremost framework for guiding the deployment of EdTech or innovations and their optimization. The ASIC framework has four tenets including Adaptation, Standardization, Integration, and Compliance. This article has presented the process of digitalizing the ASIC framework as an innovation. It has also provided provided information to guide users.

Additional Information

**Author Contributions**

All authors have reviewed the final version to be published and agreed to be accountable for all aspects of the work.

**Concept and design:** Joshua Owolabi

**Acquisition, analysis, or interpretation of data:** Joshua Owolabi

**Drafting of the manuscript:** Joshua Owolabi

**Critical review of the manuscript for important intellectual content:** Joshua Owolabi

**Disclosures**

**Human subjects:** All authors have confirmed that this study did not involve human participants or tissue.

**Animal subjects:** All authors have confirmed that this study did not involve animal subjects or tissue. **Conflicts of interest:** In compliance with the ICMJE uniform disclosure form, all authors declare the following: **Payment/services info:** All authors have declared that no financial support was received from any organization for the submitted work. **Financial relationships:** All authors have declared that they have no financial relationships at present or within the previous three years with any organizations that might have an interest in the submitted work. **Other relationships:** All authors have declared that there are no other relationships or activities that could appear to have influenced the submitted work.

References

1. [Lin F, Fofanah SS, Liang D: Assessing citizen adoption of e-Government initiatives in Gambia: A validatio](https://dx.doi.org/10.1016/j.giq.2010.09.004)n [of the technology acceptance model in information systems success. Gov Inf Q. 2011, 28:271-9.](https://dx.doi.org/10.1016/j.giq.2010.09.004) [10.1016/j.giq.2010.09.004](https://dx.doi.org/10.1016/j.giq.2010.09.004)
2. Muk A, Chung C: [Applying the technology acceptance model in a two-country study of SMS advertising](https://dx.doi.org/10.1016/j.jbusres.2014.06.001) . J

Bus Res. 2015, 68:1-6. [10.1016/j.jbusres.2014.06.001](https://dx.doi.org/10.1016/j.jbusres.2014.06.001)

1. Taherdoost H: [A review of technology acceptance and adoption models and theories](https://dx.doi.org/10.1016/j.promfg.2018.03.137) . Procedia Manuf. 2018, 22:960-7. [10.1016/j.promfg.2018.03.137](https://dx.doi.org/10.1016/j.promfg.2018.03.137)
2. [Moran J, Briscoe G, Peglow S: Current technology in advancing medical education: Perspectives for learnin](https://dx.doi.org/10.1007/s40596-018-0946-y)g [and providing care. Acad Psychiatry. 2018, 42:796-9.](https://dx.doi.org/10.1007/s40596-018-0946-y) [10.1007/s40596-018-0946-y](https://dx.doi.org/10.1007/s40596-018-0946-y)
3. [Lima D, Sotero V, Dermeval D, Artur J, Passos F: A systematic review on the use of educational technologie](https://dx.doi.org/10.5220/0007678501530160)s [for medical education. Proceedings of the 11th International Conference on Computer Supported Education](https://dx.doi.org/10.5220/0007678501530160) (CSEDU 2019), pp. 153-160. 2019, [10.5220/0007678501530160](https://dx.doi.org/10.5220/0007678501530160)
4. AlQudah AA, Al-Emran M, Shaalan K: [Technology acceptance in healthcare: A systematic review](https://dx.doi.org/10.3390/app112210537). Appl Sci. 2021, 11:10537. [10.3390/app112210537](https://dx.doi.org/10.3390/app112210537)
5. [Linderman SW, Appukutty AJ, Russo MV, Shah AP, Javaherian K: Advancing healthcare technology education and innovation in academia. Nat Biotechnol. 2020, 38:1213-7.](https://dx.doi.org/10.1038/s41587-020-0689-7) [10.1038/s41587-020-0689-7](https://dx.doi.org/10.1038/s41587-020-0689-7)
6. Fallavollita P: [Innovative technologies for medical education](https://dx.doi.org/10.5772/intechopen.68775) . InTech. 2017, [10.5772/intechopen.68775](https://dx.doi.org/10.5772/intechopen.68775)
7. [Kim JW, Myung SJ, Yoon HB, Moon SH, Ryu H, Yim JJ: How medical education survives and evolves durin](https://dx.doi.org/10.1371/journal.pone.0243958)g [COVID-19: Our experience and future direction. PLoS One. 2020, 15:e0243958.](https://dx.doi.org/10.1371/journal.pone.0243958) [10.1371/journal.pone.0243958](https://dx.doi.org/10.1371/journal.pone.0243958)
8. [Alsoufi A, Alsuyihili A, Msherghi A, et al.: Impact of the COVID-19 pandemic on medical education: Medica](https://dx.doi.org/10.1371/journal.pone.0242905)l [students' knowledge, attitudes, and practices regarding electronic learning. PLoS One. 2020, 15:e0242905.](https://dx.doi.org/10.1371/journal.pone.0242905) [10.1371/journal.pone.0242905](https://dx.doi.org/10.1371/journal.pone.0242905)
9. [Owolabi J, Bekele A: Medical educators' reflection on how technology sustained medical education in th](https://dx.doi.org/10.1177/20552076211059358)e [most critical times and the lessons learnt: Insights from an African medical school. Digit Health. 2021,](https://dx.doi.org/10.1177/20552076211059358) 7:20552076211059358. [10.1177/2055207621105935](https://dx.doi.org/10.1177/20552076211059358)8
10. [Tuma F, Kamel MK, Shebrain S, Ghanem M, Blebea J: Alternatives surgical training approaches during COVID-19 pandemic. Ann Med Surg (Lond). 2021, 62:253-7.](https://dx.doi.org/10.1016/j.amsu.2021.01.057) [10.1016/j.amsu.2021.01.057](https://dx.doi.org/10.1016/j.amsu.2021.01.057)
11. [Jeffries PR, Bushardt RL, DuBose-Morris R, et al.: The role of technology in health professions education during the COVID-19 pandemic. Acad Med. 2022, 97:S104-9.](https://dx.doi.org/10.1097/ACM.0000000000004523) [10.1097/ACM.0000000000004523](https://dx.doi.org/10.1097/ACM.0000000000004523)
12. [Alsaif BS, Ibrahem UM, Alblaihed MA, et al.: Medical education and the epidemics: How educationa](https://www.jstor.org/stable/27288771)l [technology responded. Afr J Reprod Health. 2024, 28:94-109.](https://www.jstor.org/stable/27288771)
13. [Liang JZ, Ng DK, Raveendran V, et al.: The impact of online education during the Covid-19 pandemic on th](https://dx.doi.org/10.1371/journal.pone.0296367)e [professional identity formation of medical students: A systematic scoping review. PLoS One. 2024,](https://dx.doi.org/10.1371/journal.pone.0296367) 19:e0296367. [10.1371/journal.pone.0296367](https://dx.doi.org/10.1371/journal.pone.0296367)
14. [Voss M, Geniets A, Winters N: Strategies for digital clinical teaching during the COVID pandemic: A scopin](https://dx.doi.org/10.1007/s40670-023-01894-w)g [review. Med Sci Educ. 2024, 34:219-35.](https://dx.doi.org/10.1007/s40670-023-01894-w) [10.1007/s40670-023-01894-w](https://dx.doi.org/10.1007/s40670-023-01894-w)
15. [Owolabi J: Proposing a framework guide for the integration of educational technologies and innovation](https://dx.doi.org/10.2147/AMEP.S338262)s [into the teaching of anatomy and medical sciences: The ASIC framework. Adv Med Educ Pract. 2021,](https://dx.doi.org/10.2147/AMEP.S338262) 12:1277-82. [10.2147/AMEP.S33826](https://dx.doi.org/10.2147/AMEP.S338262)2
16. [Owolabi J: ASIC framework simplified and operationalised - An operational matrix for optimising the use of technologies and innovations in medical education. Adv Med Educ Pract. 2022, 13:149-56.](https://dx.doi.org/10.2147/AMEP.S351642) [10.2147/AMEP.S35164](https://dx.doi.org/10.2147/AMEP.S351642)2
17. [Owolabi JO: The ASIC framework: An alternative operational matrix to support the technology an](https://dx.doi.org/10.30476/ijvlms.2022.93833.1125)d [innovations in medical education based on the primary learning domains. Interdiscip J Virtual Lea](https://dx.doi.org/10.30476/ijvlms.2022.93833.1125)rn Med Sci. 2022, 13:141-7. [10.30476/ijvlms.2022.93833.1125](https://dx.doi.org/10.30476/ijvlms.2022.93833.1125)
18. [Owolabi JO, Ojiambo R, Seifu D, Nishimwe A, Masimbi O, Okorie E, Ineza D: A study of anatomy teachers' perception and acceptance of the anatomage table technology and digital teaching materials in the training of medical and allied health students. Cureus. 2022, 14:e32163.](https://dx.doi.org/10.7759/cureus.32163) [10.7759/cureus.32163](https://dx.doi.org/10.7759/cureus.32163)
19. [Owolabi J, Ojiambo R, Seifu D, et al.: African medical educators and anatomy teachers' perceptions an](https://dx.doi.org/10.2147/AMEP.S358702)d [acceptance of the anatomage table as an EdTech and innovation: A qualitative study. Adv Med Educ Pr](https://dx.doi.org/10.2147/AMEP.S358702)act. 2022, 13:595-607. [10.2147/AMEP.S35870](https://dx.doi.org/10.2147/AMEP.S358702)2
20. [Owolabi J, Grant P: EdTech and Innovations for Anatomical Education in the 21st Century- A Scopin](https://scholar.google.com/scholar?q=intitle%3AEdTech%20and%20Innovations%20for%20Anatomical%20Education%20in%20the%2021st%20Century-%20A%20Scoping%20Review.%20MSc%20Medical%20Education%20Thesis%2C%20University%20of%20South%20Wales%2C%20UK)g [Review. MSc Medical Education Thesis, University of South Wales, UK. 2022.](https://scholar.google.com/scholar?q=intitle%3AEdTech%20and%20Innovations%20for%20Anatomical%20Education%20in%20the%2021st%20Century-%20A%20Scoping%20Review.%20MSc%20Medical%20Education%20Thesis%2C%20University%20of%20South%20Wales%2C%20UK)
21. Knowles MS: [The Modern Practice of Adult Education: From Pedagogy to Andragogy](https://www.umsl.edu/~henschkej/articles/a_The_%20Modern_Practice_of_Adult_Education.pdf) . Cambridge, New York; 1980.
22. Lowe SD: [Adult learning theory and online learning](https://books.google.co.in/books?id=JQIoDwAAQBAJ&printsec=frontcover&source=gbs_ge_summary_r&cad=0%23v%3Donepage&q&f=false) . Best Practices of Online Education: A Guide for Christian Higher Education. Maddix MA, Estep JR, Lowe ME (ed): IAP Information Age Publishing, Charlotte, NC; 2012. 17-30.
23. Plass JL, Moreno R, Brünken R: [Cognitive Load Theory](https://dx.doi.org/10.1017/CBO9780511844744). Cambridge University Press, Cambridge, UK; 2010. [10.1017/CBO9780511844744](https://dx.doi.org/10.1017/CBO9780511844744)
24. Sweller J: [Cognitive load theory](https://dx.doi.org/10.1016/B978-0-12-387691-1.00002-8). The Psychology of Learning and Motivation: Cognition in Education. [Mestre JP, Ross BH (ed): Elsevier Academic Press, Cambridge, MA; 2011. 37-76. 10.1016/B978-0-12-387691](https://dx.doi.org/10.1016/B978-0-12-387691-1.00002-8)- [1.00002-8](https://dx.doi.org/10.1016/B978-0-12-387691-1.00002-8)
25. Miller GE: [The assessment of clinical skills/competence/performance](https://dx.doi.org/10.1097/00001888-199009000-00045) . Acad Med. 1990, 65:S63-7. [10.1097/00001888-199009000-00045](https://dx.doi.org/10.1097/00001888-199009000-00045)
26. [Witheridge A, Ferns G, Scott-Smith W: Revisiting Miller's pyramid in medical education: The gap between traditional assessment and diagnostic reasoning. Int J Med Educ. 2019, 10:191-2.](https://dx.doi.org/10.5116/ijme.5d9b.0c37) [10.5116/ijme.5d9b.0c37](https://dx.doi.org/10.5116/ijme.5d9b.0c37)
27. Kolb DA: [Experiential Learning: Experience as the Source of Learning, Vol. 1](https://www.researchgate.net/publication/235701029_Experiential_Learning_Experience_As_The_Source_Of_Learning_And_Development) . Prentice-Hall, Englewood Cliffs, NJ; 1984.
28. [Wijnen-Meijer M, Brandhuber T, Schneider A, Berberat PO: Implementing Kolb´s experiential learning cycl](https://dx.doi.org/10.1177/23821205221091511)e [by linking real experience, case-based discussion and simulation. J Med Educ Curric Dev. 2022,](https://dx.doi.org/10.1177/23821205221091511) 9:23821205221091511. [10.1177/2382120522109151](https://dx.doi.org/10.1177/23821205221091511)1
29. Bloom BS: [Taxonomy of Educational Objectives, Handbook: The Cognitive Domain](https://eclass.uoa.gr/modules/document/file.php/PPP242/Benjamin%20S.%20Bloom%20-%20Taxonomy%20of%20Educational%20Objectives%2C%20Handbook%201_%20Cognitive%20Domain-Addison%20Wesley%20Publishing%20Company%20%281956%29.pdf) . David McKay Publications, Philadelphia, PA; 1956.
30. Adams NE: [Bloom's taxonomy of cognitive learning objectives](https://dx.doi.org/10.3163/1536-5050.103.3.010) . J Med Libr Assoc. 2015, 103:152-3. [10.3163/1536-5050.103.3.010](https://dx.doi.org/10.3163/1536-5050.103.3.010)
31. Fleming ND, Mills C: [Not another inventory, rather a catalyst for reflection](https://dx.doi.org/10.1002/j.2334-4822.1992.tb00213.x). Improv Acad J Educ Dev. 1992,

11:137. [10.1002/j.2334-4822.1992.tb00213.x](https://dx.doi.org/10.1002/j.2334-4822.1992.tb00213.x)

1. Brumpton K, Kitchener S, Sweet L: [Learning styles in vertically integrated teaching](https://dx.doi.org/10.1111/tct.12024) . Clin Teach. 2013, 10:282-6. [10.1111/tct.12024](https://dx.doi.org/10.1111/tct.12024)
2. [ASIC EdTech Framewor](https://asicedtech.com/)k. (2024). Accessed: May 19, 2024: [https://asicedtech.com](https://asicedtech.com/)/.
3. [Zhang W, Cai M, Lee HJ, Evans R, Zhu C, Ming C: AI in medical education: Global situation, effects and challenges. Educ Inf Technol. 2023, 29:1-23.](https://dx.doi.org/10.1007/s10639-023-12009-8) [10.1007/s10639-023-12009-8](https://dx.doi.org/10.1007/s10639-023-12009-8)
4. [Sridharan K, Sequeira RP: Artificial intelligence and medical education: Application in classroom instruction and student assessment using a pharmacology &amp; therapeutics case study. BMC](https://dx.doi.org/10.1186/s12909-024-05365-7) Med Educ. 2024, 24:431. [10.1186/s12909-024-05365-7](https://dx.doi.org/10.1186/s12909-024-05365-7)
5. Flexner A: [Medical Education in the United States and Canada](http://archive.carnegiefoundation.org/publications/pdfs/elibrary/Carnegie_Flexner_Report.pdf). The Merrymount Press, Boston; 1910.
6. Duffy TP: [The Flexner report ― 100 years later](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3178858/) . Yale J Biol Med. 2011, 84:269-76.
7. Ertmer PA: [Addressing first- and second-order barriers to change: Strategies for technology integration](https://dx.doi.org/10.1007/BF02299597) . Educ Technol Res Dev. 1999, 47:47-61. [10.1007/BF02299597](https://dx.doi.org/10.1007/BF02299597)
8. Sale K: [The achievements of 'General Ludd': A brief history of the Luddites](http://ink.gale.com/apps/doc/A55576275/AONE?u=txshrpub100416&sid=googleScholar&xid=ce32a20) . Ecologist. 1999, 29:310.
9. Jones SE: [Against Technology: From the Luddites to Neo-Luddism](https://www.routledge.com/Against-Technology-From-the-Luddites-to-Neo-Luddism/Jones/p/book/9780415978682). Routledge, New York; 2006.
10. Cohen AF, Ritter JM: [Industrialized research in the BJCP: A neo-Luddite view](https://dx.doi.org/10.1111/bcp.12000) . Br J Clin Pharmacol. 2012, 74:903-6. [10.1111/bcp.12000](https://dx.doi.org/10.1111/bcp.12000)
11. [McGowan K, Geobey S: Harmful to the commonality: The Luddites, the distributional effects of systems](https://dx.doi.org/10.1108/SEJ-11-2020-0118) [change and the challenge of building a just society. Soc Enterp J. 2022, 18:306-20. 10.1108/SEJ-11-2020](https://dx.doi.org/10.1108/SEJ-11-2020-0118)- [0118](https://dx.doi.org/10.1108/SEJ-11-2020-0118)
12. [Abdellatif AB, Djellal A, Abdellatif T, Ismail I: Study of resistance to digital applications in healthcar](https://ssrn.com/abstract%3D2911066)e [organizations. J Hum Cult Stud. 2017, 2:1-20.](https://ssrn.com/abstract%3D2911066)
13. [Safi S, Thiessen T, Schmailzl KJ: Acceptance and resistance of new digital technologies in medicine](https://dx.doi.org/10.2196/11072): [Qualitative study. JMIR Res Protoc. 2018, 7:e11072.](https://dx.doi.org/10.2196/11072) [10.2196/11072](https://dx.doi.org/10.2196/11072)
14. [Han ER, Yeo S, Kim MJ, Lee YH, Park KH, Roh H: Medical education trends for future physicians in the era o](https://dx.doi.org/10.1186/s12909-019-1891-5)f [advanced technology and artificial intelligence: An integrative review. BMC Med Educ. 2019, 19:460.](https://dx.doi.org/10.1186/s12909-019-1891-5) [10.1186/s12909-019-1891-](https://dx.doi.org/10.1186/s12909-019-1891-5)5
15. Thibault GE: [The future of health professions education: Emerging trends in the United States](https://dx.doi.org/10.1096/fba.2020-00061) . FASEB Bioadv. 2020, 2:685-94. [10.1096/fba.2020-0006](https://dx.doi.org/10.1096/fba.2020-00061)1

Advances in Medical Education and Practice [Dovepress](https://www.dovepress.com/)

open access to scientific and medical research

Open Access Full Text Article

COMMENTARY

# Proposing a Framework Guide for the Integration of Educational Technologies and Innovations into the Teaching of Anatomy and Medical Sciences: The ASIC Framework

Joshua Owolabi [](http://orcid.org/0000-0003-2880-9701)

Department of Anatomy, Division of Basic Medical Sciences, School of Medicine, University of Global Health Equity, Butaro, Burera, Rwanda



Point your SmartPhone at the code above. If you have a QR code reader the video abstract will appear. Or use: https://youtu.be/\_rIU-Nq8Fp8

Video Abstract

Correspondence: Joshua Owolabi Department of Anatomy, Division of Basic Medical Sciences, School of Medicine, University of Global Health Equity, Butaro, Burera, Rwanda

Tel +250 781164365

Email [jowolabi@ughe.org](mailto:jowolabi@ughe.org)

**Abstract:** Educational technologies are becoming important and integral to medical educa- tion and practice more than ever before. The scope and appreciation for digital medicine is also widening. No thanks to the covid-19 induced restrictions including physical distancing and lockdown measures, which has changed the mode of educational delivery in many climes. Technology became a major avenue for sustaining medical education and practice. However, what this has also revealed is the heterogeneity in the deployment of technologies and educational innovations based on factors that are linked but not limited to human and system factors. There is currently no generally accepted framework to guide the use of medical education technologies and innovations in the teaching of human anatomy to medical and allied health students. The current framework attempts to provide a framework that could work for various medical education systems, centred on four key considerations: adaptation, standardization, integration, and compliance. In this article, the ASIC framework is presented, illustrated, and succinctly discussed.

**Keywords:** anatomy, education, technology, innovation, adaptation, standardization,

integration, compliance

##### Background

Educational technologies and innovation have become significant drivers for the delivery of medical education across the world. Interestingly, not much work has been done on the need to provide a generally useful and reliable framework guide for the integration and optimal use of these educational technologies and innovation in the context of medical education. It is also important to note that variations in the types and platforms for educational technologies and innovations have kept increas- ing. While some have been produced by well-known educational industry players, stakeholders such as faculty members and designers in institutions have equally produced specific educational materials that could be categorized as educational technologies and innovations. These realities when bundled together would point to the fact that there is increasing heterogeneity or variation in the ways and manners that educational innovations and technologies are being adapted and used to deliver medical education across the world. When this is considered in line with the current realities, there has to be a significant level of standardisation, quality assurance and

Received: 8 September 2021

Accepted: 12 October 2021

Published: 2 November 2021

Advances in Medical Education and Practice 2021:12 1277–1282 **1277**

[](http://www.dovepress.com/permissions.php)© 2021 Owolabi. This work is published and licensed by Dove Medical Press Limited. The full terms of this license are available at [https://www.dovepress.com/terms.php](http://www.dovepress.com/terms.php) and incorporate the Creative Commons Attribution – Non Commercial (unported, v3.0) License [(http://creativecommons.org/licenses/by-nc/3.0/).](http://creativecommons.org/licenses/by-nc/3.0/)) By accessing the work

you hereby accept the Terms. Non-commercial uses of the work are permitted without any further permission from Dove Medical Press Limited, provided the work is properly attributed. For permission for commercial use of this work, please see paragraphs 4.2 and 5 of our Terms [(https://www.dovepress.com/terms.php).](http://www.dovepress.com/terms.php))

best practices that should be achieved in order to globally sustain the quality of medical education delivery. There is a need to provide a framework guide. This article therefore provides the ASIC framework for the adaptation, standar- disation, integration of educational technologies and inno- vations including the need to ensure compliance with best practices within programme structures.

##### Brief Review of Literature

Various types of technologies and innovations have been used to teach Anatomy and Basic Medical Sciences, espe- cially in recent times.[1–3](#_bookmark12) These had included hardware technologies [eg, the Anatomage Table, the Anatomy Magic Mirror], software [eg, Zygote and the Complete 3D Anatomy software],[4](#_bookmark13) virtual realities,[5](#_bookmark14) Simulations,[6](#_bookmark15) augmented reality facilities [eg, high fidelity mannequin][7](#_bookmark16),[8](#_bookmark17) as well as the use of customised 3D printed materials.[9](#_bookmark18),[10](#_bookmark19) These innovations are accompanied by var- iations in approaches to delivering and facilitating medical education. Remote learning adjusted class structures and blended learning methods have become quite popular. The variations in institutional tech culture, stakeholders embrace versus aversion to technology as well as skills or proficiency levels, availability of supportive systems, leadership, institutional policies, and practices arguably caused significant variations in how technologies and innovations are being used. While it is increasingly becoming clear that technologies and innovations can ade- quately support and significantly enhance the delivery of medical education,[11](#_bookmark20),[12](#_bookmark21) there has been advocacy for reg- ulations and standardisation. The disparities in resources availabilities and the quality of the resources, as well as the systemic support for practical and adequate integration of technologies might be partly due to gaps in funding and infrastructural support between the developed and the developing countries. This has been implicated for why there might have been significant disparities in the deploy- ment of educational technologies and innovations. To be able to set standards, however, there has to be a framework of reference.

##### The Proposed ASIC Framework

The ASIC framework, as proposed [[Figure 1](#_bookmark5)], provides a guide, developed from extensive consideration for learn- ing theories, pedagogical principles and reflective practice based on experience. It also considers the need to address the heterogeneity in the contexts of deployment of tech- nology educational technologies and innovations. The

proposed ASIC framework is based on four key terms – Adaptation, Standardisation, Integration and Compliance. This is further illustrated as follows:

A- Adaptation: Innovation and technology should be suitably adapted to programme design and institutional system for optimal performance and best outcomes.

S- Standardisation: Clearly determining the purpose that innovations and technologies serve, the objectives they meet; and supporting their uses with evidence for best and standard practices.

I- Integration: Creating a place for the use of educa- tional innovations and technology; and aligning its use with other components of the educational system for opti- mal performance.

C- Compliance: Evidence of compliance with institu- tional standards, programme requirements and regulations of relevant bodies should be addressed.

The ASIC framework [[Figure 1](#_bookmark5)] provides guidance on how the four key considerations could be aligned with the cognitive [knowledge], psychomotor [skills] and affective [attitude] aspects of education delivery. Very importantly, it highlights that fact that there should be evidence on how the technology is helping to achieve programme objectives based on outlined milestones. As much as it is practical, each session’s objective[s] and the process of accomplish- ing the objectives should provide an opportunity for the ASIC framework to guide holistic integration of the pur- pose of use based on the ASIC framework with evidence of such accomplishment in one or more of the KSA domains, as originally premised on programme outcomes and milestones derived from them.

##### Making a Case for the ASIC Framework

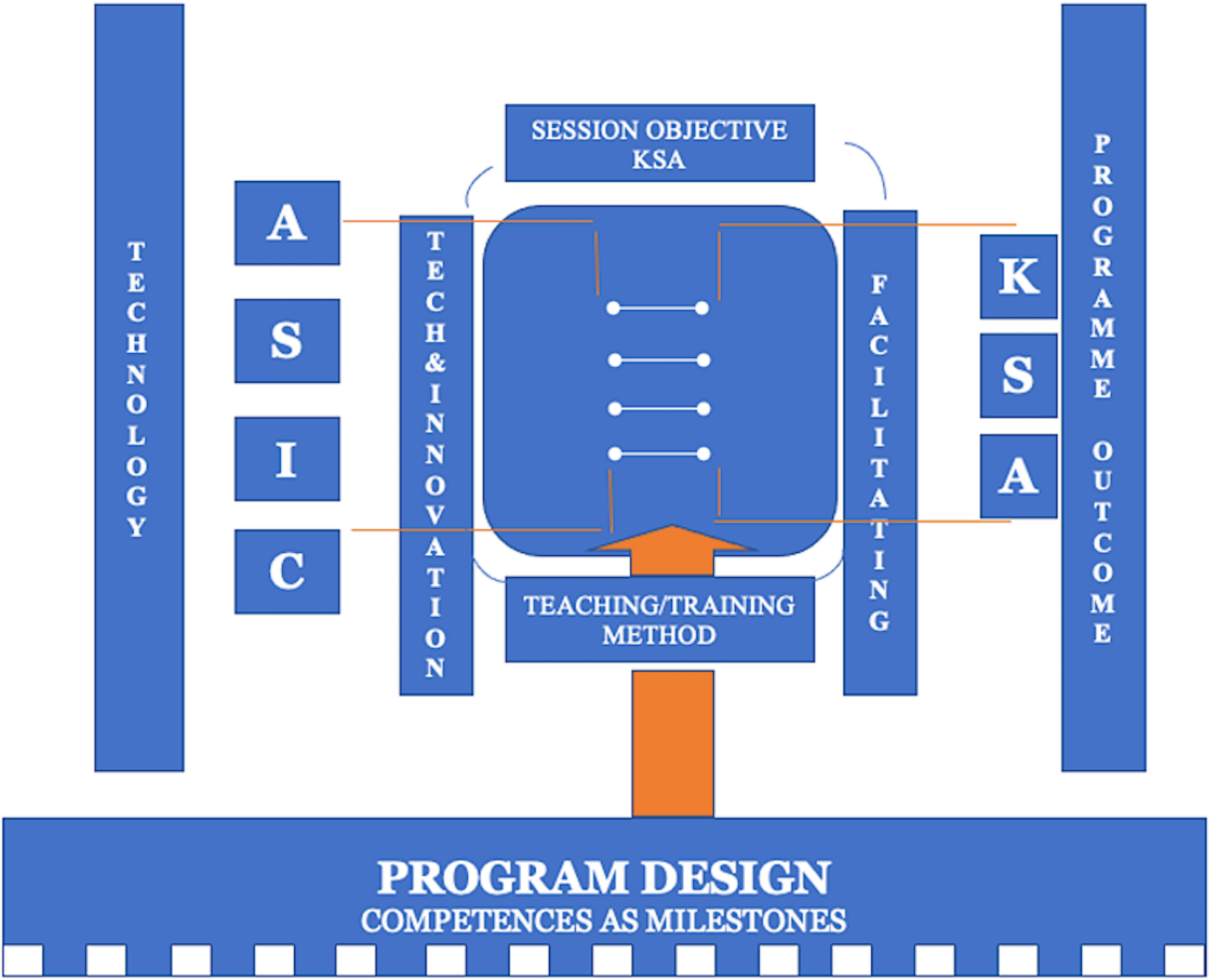
The implications of negatively disruptive deployment of technology in the teaching of anatomy and medical sciences might be dire and possibly far reaching than anticipated. This proposed framework [[Figure 1](#_bookmark5)] could guide medical educators in their use of technology for medical education. Therefore, when deploying educational technologies and innovations, it is therefore important to consider the educational theories, pedagogical principles, and best practices to support their uses for facilitating teaching and training sessions. Finally, with growing inter- est in educational technologies and innovations as well as digital medicine, developing a tech culture and ensuring proper technology integration have become vital to the

**1278**

**https://doi.org/10.2147/AMEP.S338262**

[DovePress](https://www.dovepress.com/)

Advances in Medical Education and Practice 2021:12



**Figure 1** Figure showing the concept of the ASIC framework. The framework considers four major factors including adaptation [A], standardization [S], integration [I], and compliance [C]. The framework equally provides a guide on how the use of technologies and innovations could be carefully aligned with program outcomes as well as competences and milestones based on program design and expected outcomes.

**Abbreviations**: K, knowledge; S, skill; A, attitude; ASIC, adaptation [A], standardization [S], integration [I], and compliance [C].

advancement of anatomical sciences and medical educa- tion. The following sections further consider the impor- tance of each aspect or tenet of the ASIC Framework.

###### Adaptation

The case for adaptation is very important, especially when considering the fact that systems often times vary not just in terms of curricular variant and philosophy, infrastruc- ture and technological setup and support, but also in terms of the culture of learning, policies and standard practices. It would therefore be important to lessen emphasis on uniformity particularly considering the current realities but to ensure proper adaptations that could help to opti- mise the use of educational technologies and innovations.

When room is provided for adaptation opportunity, ade- quate latitude will be given to stakeholders to determine how best existing and emerging innovations and technol- ogies can serve the purposes of learning, in line with programme design and objectives. Furthermore, there are variants and sub-variants of medical education curricula which suggest that it might be impractical to expect all systems to use these innovations and technology in exactly the same ways. Therefore, allowing for adaptation would help to suitably deploy educational innovations and tech- nologies in order to achieve specific program objectives as determined by the program stakeholders including the concerned institutions, authorities and regulatory bodies. It is also important to deploy technologies and innovations

Advances in Medical Education and Practice 2021:12 **https://doi.org/10.2147/AMEP.S338262**

[DovePress](https://www.dovepress.com/)

**1279**

most appropriately and effectively, noting the variations in the purposes that they serve, as well as the strengths and potential deficiencies.[13](#_bookmark22)

###### Standardisation

Standardization will ensure that evidence-based practices are ensured while adopting, adapting, and deploying edu- cational technologies and innovations to deliver medical education. Adhering to the tenets of standardization would emphasize the need to consider appropriate pedagogies while deploying medical education technology. This con- sideration will also ensure that learning theories are con- sidered. Another way of illustrating the role of standardization is to state that educational technologies and innovation are deployed in practical and scientific manners whereby empirical evidence is used to support practices. For example, the use and choice of augmented reality to teach human anatomy to medical students should be supported by empirical evidence as well as a clear indication of how such a method can help to achieve learning objectives in the context of use. In addition to the need for teachers to ensure the standardisation of their use of educational technologies and innovations, regula- tory bodies can also provide a set of guide and require- ments for the general use of technologies, yet not limiting creative adaptation and latitude of use. Standardisation is a key consideration in efforts to optimise the benefits of educational technologies and innovations.[14](#_bookmark23)

###### Integration

Integration emphasises the need to use educational tech- nologies and innovations in alignment and in synergy with other technologies and innovations and the entire infra- structure setup to deliver medical education. It is expedient to ensure that the educational technologies and innovations are not negatively disruptive. Proper consideration should be put into how new tools fits into existing systems. Learning tools that are complimentary should specifically meet certain needs with evidence or prospects that their use will enhance the delivery of medical education. Those that are used to replace outdated learning tools and meth- ods including those that are no more feasible and practic- able should also satisfy the requirements of their use in specific contexts to deliver medical education. This should be done in line with program objectives whenever possible and necessary. It might be expedient to align their uses with program milestones. Altogether, system thinking should guide the introduction, adaptation and integration

of new and emerging educational technologies and inno- vations into medical education systems. For example, soft- ware that have plug-in enablement might be integrated into the learning management system [LMS]. Stand-alone edu- cational technologies and innovation such as the hardware should be allocated specific time in the schedule of events, especially in the syllabus with the specific objectives that their uses will achieve clearly identified and indicated both to students and other stakeholders. The need for adequate integration has been previously highlighted.[15](#_bookmark24)

###### Compliance

Compliance equally emphasizes best practices with speci- fic emphasis on requirements that bother on institutional standards and regulatory bodies requirements, and pro- gram outcomes amongst others. For example, certain stand-alone technologies such as the Anatomy magic mir- ror, the Google Glass and the Anatomage table technology might be great at teaching anatomical concepts, structural organisation, and the required knowledge of functions. Also, the use of high-fidelity manikin might be great at teaching clinical concepts and simulating skills. Therefore, there should be evidence that the use of educational tech- nologies and innovations meet the criteria for compliance as determined by relevant stakeholders and regulatory bodies, especially those with program oversight functions. For the users, the need for compliance would also speak to the need by faculty members and students to have the requisite knowledge and skill to optimally use the tools.[16](#_bookmark25) It is in this vein that it might be important that stakeholders and regulatory bodies would expand their regulations to consider use of educational technologies and innovations in order to satisfy the requirement of compliance. This, however, should be done with quality intentions and adequate appreciation for the role and place of educational technologies and innovations, devoid of extreme regimentation that might limit users’ creativity and latitude for adaptation.

While there has been quality and increasing evidence

about the importance of medical education technologies and innovation in the delivery of medical education and training in the 21st century, what is equally clear is the need to address specific concerns about how to optimize the use of these technologies and innovations. Standardization is one key term that have stood out. This is not unconnected with the relative heterogeneity in con- texts and educational cultures within which these educa- tional technologies and innovations are being deployed.

**1280**

**https://doi.org/10.2147/AMEP.S338262**

[DovePress](https://www.dovepress.com/)

Advances in Medical Education and Practice 2021:12

Other factors may also be associated with system-related factors such as the quality of infrastructural support, emphasis on educational theories or pedagogical princi- ples, educators’ skills in the domain of medical education as well as the quality of medical education leadership amongst other important factors. For example, the need to advance computer assisted instruction through research and roadmap [or framework] has been highlighted.[17](#_bookmark26),[18](#_bookmark27)

Roadmaps, frameworks, and guiding principles are always important to implementing new educational pro- grammes and strategies. It is, therefore, important to note that the ASIC framework can help to achieve this with regard to medical education technologies and innovations. It can also promote the integration of professionalism into medical education, first with medical educators appreciating the place of learning theories and pedagogical principles in the deployment of medical education technologies and innovation, and consequently imbibing these into the cul- ture of learning and practice of the students and trainees. These could therefore add significant value in the affective domain of learning. It also provides significant value in the domain of the hidden curriculum. Even with traditional practices such cadaveric dissection, professionalism and adherence to ethics that emphasise certain standard prac- tices that are equally supported with quality evidence have been advocated for in the past.[19](#_bookmark28),[20](#_bookmark29) Certain hidden curricu- lum benefits from the use of medical education technologies and innovations following the ASIC Framework would include enshrining a tech-culture in medical education and promoting professionalism with best practices in the use of such technologies and innovations.

##### Summary and Conclusion

This framework provides a guide, developed for extensive consideration for learning theories, pedagogical principles and reflective practice based on adequate experience [[Figure 1](#_bookmark5)]. It provides a framework for the introduction, effective utilization and optimal deployment of education technologies and innovations to deliver medical education. The framework has also considered four major factors including adaptation, standardization, integration, and com- pliance. The framework equally provides a guide on how the use of technologies and innovations could be carefully aligned with program outcomes as well as competences and milestones based on program design and expected outcomes. Furthermore, it provides guidance on how the four key con- siderations could be aligned with the cognitive [knowledge], psychomotor [skills] and affective [attitude] aspects of

education delivery. While the framework considers the big picture of the entire medical education delivery, it also con- siders the need to give adequate considerations to these factors with every opportunity to use educational technolo- gies and innovations such as in classrooms as well as simula- tion rooms. It should be stated, finally, that while this framework is recommended for use, continuous effort is being invested into further studies to validate and improve the effectiveness of its use as a reference guide.

##### Disclosure

The author reports no conflicts of interest in this work.

##### References

1. Fallavollita P. Innovative technologies for medical education, human anatomy - reviews and medical advances, Alina Maria Sisu. *IntechOpen*. [2017](#_bookmark0). [doi:10.5772/intechopen.68775](https://doi.org/10.5772/intechopen.68775)
2. Zargaran A, Turki MA, Bhaskar J, Spiers H, Zargaran D. The role of technology in anatomy teaching: striking the right balance. *Advan Med Educ Pract*. [2020](#_bookmark30);11:259–266. [doi:10.2147/AMEP.S240150](https://doi.org/10.2147/AMEP.S240150)
3. Dawidziuk A, Kawka M, Szyszka B, Wadunde I, Ghimire A. Global access to technology-enhanced medical education during the COVID-19 pandemic: the role of students in narrowing the gap. *Glob Health Sci Pract*. 2021;9(1):10–14. [doi:10.9745/GHSP-D-20-](https://doi.org/10.9745/GHSP-D-20-00455) [00455](https://doi.org/10.9745/GHSP-D-20-00455)
4. Santana EA, Orquera PA, Valenzuela JJ, Orellana MI, Gold MH, De La Paz Garcia G. Anatomical software as a tool in the teaching-learning process of human anatomy. Literature review. *FASEB J*. [2020](#_bookmark1);34:1. [doi:10.1096/fasebj.2020.34.s1.09262](https://doi.org/10.1096/fasebj.2020.34.s1.09262)
5. Zhao J, Xu X, Jiang H, et al. The effectiveness of virtual reality-based technology on anatomy teaching: a meta-analysis of randomized controlled studies. *BMC Med Educ*. [2020](#_bookmark1);20:127. doi:10.1[186/s12909-020-1994-z](https://doi.org/10.1186/s12909-020-1994-z)
6. Kurt E, Yurdakul SE, Ataç A. An overview of the technologies used for anatomy education in terms of medical history. *Procedia*. [2013](#_bookmark1);103:109–115. [doi:10.1016/j.sbspro.2013.10.314](https://doi.org/10.1016/j.sbspro.2013.10.314)
7. Campisi CA, Li EH, Jimenez DE, Milanaik RL. Augmented reality in medical education and training: from physicians to patients. In: Geroimenko V, editor. *Augmented Reality in Education. Springer Series on Cultural Computing*. Cham: Springer; [2020](#_bookmark2). [doi:10.1007/](https://doi.org/10.1007/978-3-030-42156-4_7) [978-3-030-42156-4\_7.](https://doi.org/10.1007/978-3-030-42156-4_7)
8. Parsons D, MacCallum K. Current perspectives on augmented reality in medical education: applications, affordances and limitations. *Adv* *Med Educ Pract*. [2021](#_bookmark2);12:77–91. [doi:10.2147/AMEP.S249891](https://doi.org/10.2147/AMEP.S249891)
9. McMenamin PG, Quayle MR, McHenry CR, et al. The production of anatomical teaching resources using three-dimensional (3D) printing technology. *Anat Sci Educ*. [2014](#_bookmark3);7(6):479–486. [doi:10.1002/ase.v7.6](https://doi.org/10.1002/ase.v7.6)
10. Reyes GJP, Valle TCJ, Soto UV, Herrera VI, Pineda MD, Garcia GAA. New technologies applied to the study and application of digital anatomy. HDM project (human dissection models)- 5 years of experience. *Ann Med*. [2019](#_bookmark3);51:sup1,56. [doi:10.1080/](https://doi.org/10.1080/07853890.2018.1561926) [07853890.2018.1561926](https://doi.org/10.1080/07853890.2018.1561926)
11. Goh PS. eLearning or technology enhanced learning in medical education - hope, not hype. *Med Teacher*. [2016](#_bookmark4);38(9):957–958. [doi:10.3109/0142159X.2016.1147538](https://doi.org/10.3109/0142159X.2016.1147538)
12. Owolabi J, Bekele A. Implementation of innovative educational technologies in teaching of anatomy and basic medical sciences during the COVID-19 pandemic in a developing country: the COVID-19 silver lining? *Adv Med Educ Pract*. [2021](#_bookmark4);12:619–625. [doi:10.2147/AMEP.S295239](https://doi.org/10.2147/AMEP.S295239)

Advances in Medical Education and Practice 2021:12 **https://doi.org/10.2147/AMEP.S338262**

[DovePress](https://www.dovepress.com/)

**1281**

1. Guze PA. Using technology to meet the challenges of medical education. *Trans Am Clin Climatol Assoc*. [2015](#_bookmark6);126:260–270.
2. Moran J, Briscoe G, Peglow S. Current technology in advancing medical education: perspectives for learning and providing care. *Acad Psychiatry*. [2018](#_bookmark7);42:796–799. [doi:10.1007/s40596-018-0946-y](https://doi.org/10.1007/s40596-018-0946-y)
3. Han ER, Yeo S, Kim MJ, et al. Medical education trends for future physicians in the era of advanced technology and artificial intelli- gence: an integrative review. *BMC Med Educ*. [2019](#_bookmark8);19:460. doi:10.1[186/s12909-019-1891-5](https://doi.org/10.1186/s12909-019-1891-5)
4. Grimwood T, Snell L. The use of technology in healthcare education: a literature review’. *MedEdPublish*. [2020](#_bookmark9);9(1):137. [doi:10.15694/](https://doi.org/10.15694/mep.2020.000137.1) [mep.2020.000137.1](https://doi.org/10.15694/mep.2020.000137.1)
5. Berman NB, Fall LH, Maloney CG, et al. Computer-assisted instruc- tion in clinical education: a roadmap to increasing CAI implementation. *Adv Health Sci Educ*. [2008](#_bookmark10);13:373–383. [doi:10.1007/s10459-006-9041-3](https://doi.org/10.1007/s10459-006-9041-3)
6. Cook DA. The research we still are not doing: an agenda for the study of computer-based learning. *Acad Med*. [2005](#_bookmark10);80(6):541–548. [doi:10.1097/00001888-200506000-00005](https://doi.org/10.1097/00001888-200506000-00005)
7. Ghosh SK. The practice of ethics in the context of human dissection: setting standards for future physicians. *Ann Anat*. [2020](#_bookmark11);232:151577. [doi:10.1016/j.aanat.2020.151577](https://doi.org/10.1016/j.aanat.2020.151577)
8. Ghosh SK, Kumar A. Building professionalism in human dissection room as a component of hidden curriculum delivery: a systematic review of good practices. *Anat Sci Educ*. [2019](#_bookmark11);12(2):210–221. [doi:10.1002/ase.1836](https://doi.org/10.1002/ase.1836)

Advances in Medical Education and Practice

**Publish your work in this journal**

Advances in Medical Education and Practice is an international, peer- reviewed, open access journal that aims to present and publish research on Medical Education covering medical, dental, nursing and allied health care professional education. The journal covers undergraduate education, postgraduate training and continuing medical education

[Dovepress](https://www.dovepress.com/)

including emerging trends and innovative models linking education, research, and health care services. The manuscript management system is completely online and includes a very quick and fair peer-review system. Visit <http://www.dovepress.com/testimonials.php> to read real quotes from published authors.

**Submit your manuscript here:** <http://www.dovepress.com/advances-in-medical-education-and-practice-journal>

**[](https://www.facebook.com/DoveMedicalPress/)[](https://twitter.com/dovepress)[](https://www.linkedin.com/company/dove-medical-press)[](https://www.youtube.com/user/dovepress)1282**

[DovePress](https://www.dovepress.com/) Advances in Medical Education and Practice 2021:12

Advances in Medical Education and Practice [Dovepress](https://www.dovepress.com/)

open access to scientific and medical research

Open Access Full Text Article

COMMENTARY

# ASIC Framework Simplified and Operationalised – An Operational Matrix for Optimising the Use of Technologies and Innovations in Medical Education

*Advances in Medical Education and Practice downloaded from* [*https://www.dovepress.com/*](http://www.dovepress.com/) *For personal use only.*

Joshua Owolabi [](http://orcid.org/0000-0003-2880-9701)

Anatomy Department, Division of Basic Medical Sciences, University of Global Health Equity, Butaro, Rwanda Correspondence: Joshua Owolabi, Email [jowolabi@ughe.org](mailto:jowolabi@ughe.org)

**Abstract:** The ASIC [adaptation, standardisation, integration and compliance] framework was developed to set the standard for the use of innovations and technologies in medical education. There is a need to develop frameworks and reference guides for educational technologies [EdTechs] and innovations, noting that EdTechs are becoming increasingly important to the delivery of medical education. The ASIC framework as previously published presents four major tenets including: adaptation, standardisation, integration and compliance. The operational matrix is now developed and presented in this article. Each tenet of the ASIC framework has key requirements or questions that the user of an EdTech or educational innovation should address. Each question represents a key requirement to be satisfied by the user of the EdTech to satisfy the ASIC tenets. Each question is also equally weighted as every other one. The matrix has 12 key questions, representing 12 key requirements. The results measurement can either be a fraction of 12 or a percentage. As a requirement, the minimum score under each category is 2 out of 3; ideally, optimisation of an educational innovation or technology requires that all boxes are checked in the affirmative. However, a minimum of 2 out of 3 in every category would indicate a minimum score or threshold. This effort is in line with previous and ongoing efforts to ensure that educational technologies and innovation that are deployed to deliver medical education are adapted for optimal performance, standardised for the use of training, integrated into the medical education delivery system, and compliant with professional, institutional, and regulatory standards.

**Keywords:** innovation, technology, medical education, ASIC, framework, operational matrix, adaptation, standardisation, integration,

compliance

##### Introduction

The ASIC framework was recently published, as a framework that can help to optimize the introduction and use of innovations and educational technology in the delivery of medical education.[1](#_bookmark44) A major consideration that warranted the development of the framework is the fact that innovations and educational technologies are becoming increasingly important and integral the delivery of medical education, especially Anatomy.[2–6](#_bookmark46) For example, functional and clinical anatomy requires extensive exploration of the human body including its systems and their functions, hence, EdTechs in certain instances have been able to combine quality digital representation of the human body with simulations of functional phenomena, structural aberrations and procedures of interventions. Furthermore, EdTechs and educational innovations are becoming more diverse while the degrees of sophistication of the innovations and technologies have also increased; a situation that could become increasingly complex or even complicated. Consequently, the types of innova- tions and technologies that are being used could vary greatly from place to place. In addition, the manner in which such innovations and technologies are being used could also greatly vary based on a number of factors that might include educators and stakeholders’ interests in technology, and the prevalent teaching and learning culture.[7](#_bookmark47) Other influencing factors could include the type of curriculum being operationalized, the time allocated to the use of technology, acceptability of technology by learners, educators and other stakeholders within educational systems, the main regulatory

Received: 28 November 2021

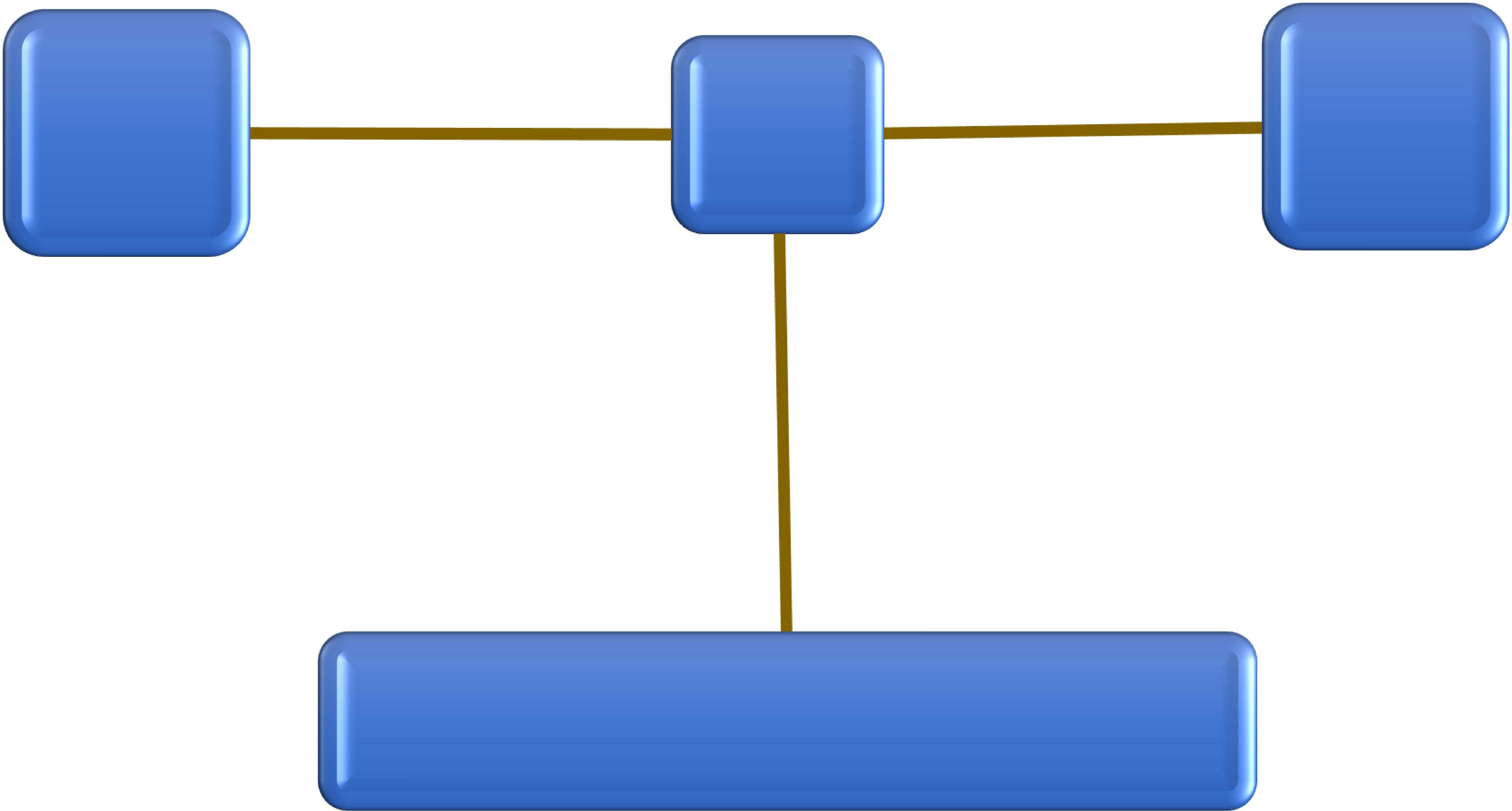
Accepted: 2 February 2022

Published: 9 February 2022

Advances in Medical Education and Practice 2022:13 149–156 **149**

[](http://www.dovepress.com/permissions.php)© 2022 Owolabi. This work is published and licensed by Dove Medical Press Limited. The full terms of this license are available at [https://www.dovepress.com/terms.php](http://www.dovepress.com/terms.php) and incorporate the Creative Commons Attribution – Non Commercial (unported, v3.0) License [(http://creativecommons.org/licenses/by-nc/3.0/).](http://creativecommons.org/licenses/by-nc/3.0/)) By accessing the work

you hereby accept the Terms. Non-commercial uses of the work are permitted without any further permission from Dove Medical Press Limited, provided the work is properly attributed. For permission for commercial use of this work, please see paragraphs 4.2 and 5 of our Terms [(https://www.dovepress.com/terms.php).](http://www.dovepress.com/terms.php))



**Figure 1** ASIC Simplified- the ASIC [Adaptation, Standardisation, Integration, and Compliance] framework linked to learning domains [Knowledge, Skill, Attitude] and curricular compliance [C]; the centre of integration, I, is always the context and space of learning such as the classroom, laboratory, simulation facilitates, hospital ward, the community.

**Abbreviations**: ASIC, Adaptation, Standardisation, Integration, Compliance; I, Integration Context or Setting eg Classroom, Laboratory, Simulation Facility etc; KSA, Knowledge, Skill, Attitude.

policies that help to oversee the delivery of medical education, institutional policies and practices as well as any other factor that could influence the use of innovations and technology at a particular point in time.

Another factor that has been identified might include economic factors such as the capacity to procure quality resources and to provide adequate infrastructural support that will serve as innovations and educational technologies.[8](#_bookmark48) Beyond just the training, it has been previously reported that inequalities and inequities might limit the benefits of technological innovation in the healthcare systems.[9](#_bookmark49) These realities might therefore imply that well-resourced institutions might have greater capacity to procure quality EdTechs and resources as well as the ability to train the users and equip them with adequate skills. Under resourced institutions on the other hand might not have such capacities. This explains why there might be a link between innovative technologies and social inequalities in health.[10](#_bookmark50) Another major considera- tion is the state of the tech culture in an institution, and this often has to do with the level of appreciation for technology that the key stakeholders in the institution might have. This, for example, can influence their decisions and positions on the extent of the use of innovative approaches and technologies to support or deliver medical education. Paradigm could also play vital roles. For example, the older generation of educators might not have come to fully appreciate the significance of technology, not just to support the delivery of medical education currently, but the roles that such innovations and technologies might play in the future, and the need to prepare for such a future by integrating a tech culture into medical education and other aspects of education in general.

With all these considerations in mind as highlighted above, it is apparent that efforts should be invested into not just

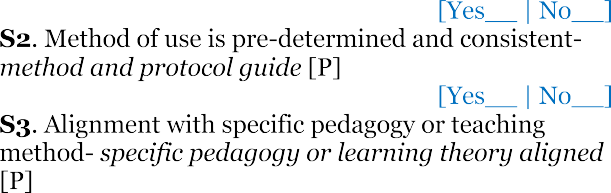
the acquisition of technologies or development of such technologies but to deploy such technologies and innovations in manners that will be optimally beneficial to learners and trainees. The ASIC framework was therefore designed and developed to serve such a purpose [[Figure 1](#_bookmark33)]. It is arguably the known foremost framework serving such purposes currently. It is believed that this framework could help to properly introduce innovations and medical education technologies into existing structures while at the same time it could help users of technology to ensure a structured approach to deploying technology in almost any context. The four key tenets of the framework include: Adaptation, Standardization, Integration, and Compliance. In the original publication of the ASIC framework, each of the tenets was broken down with explanations provided regarding what should be achieved to address each of these key tenets.[1](#_bookmark44) In this particular effort, an operational matrix is being designed and developed to help users of the ASIC framework to operationalise the use of the framework while deploying innovations and educational technologies. It also helps to

**150**

**https://doi.org/10.2147/AMEP.S351642**

[DovePress](https://www.dovepress.com/)

Advances in Medical Education and Practice 2022:13



**Figure 2** ASIC Framework Operational Matrix. ASIC Framework Operational Matrix has specific considerations under the four tenets of ASIC. Each of the tenets has 3 questions that validate it [eg A1= Adaptation-related question 1; C3= Compliance-related question 3]. The user is required to confirm each consideration [Yes] or decline [No]. Each response has an attached value. Each consideration under each ASIC tenet is coded and a specific score is allocated to it. Practically, there are overall 12 considerations that serve as the overall indicators of the operational performance level of an educational innovation or technology based on the ASIC Framework. The final outcome can be presented simply as a whole number and measured as a fraction of 12, eg 10/12. Alternatively, the score can be computed as a percentage to provide a more practical proportional representation of operational performance.

**Abbreviations**: A, Adaptation; S, Standardisation; I, Integration; C, Compliance; P, Prompt.

measure the level of performance or potential performance of such technologies, hence, measuring the degree of success deployment and consequently, optimisation of innovations and educational technologies.

##### The ASIC Framework Operational Matrix [[Figure 2](#_bookmark37)]

The ASIC Framework could help to optimise the use of an educational technology or innovation. It demands that the key competences [C] that an EdTech or innovation helps to achieve should be clearly identified. It further requires that these competences should be linked to learning in one or more basic domains ie KSA- Knowledge, Skill, Attitude. The practical use of this framework could be highlighted as follows:

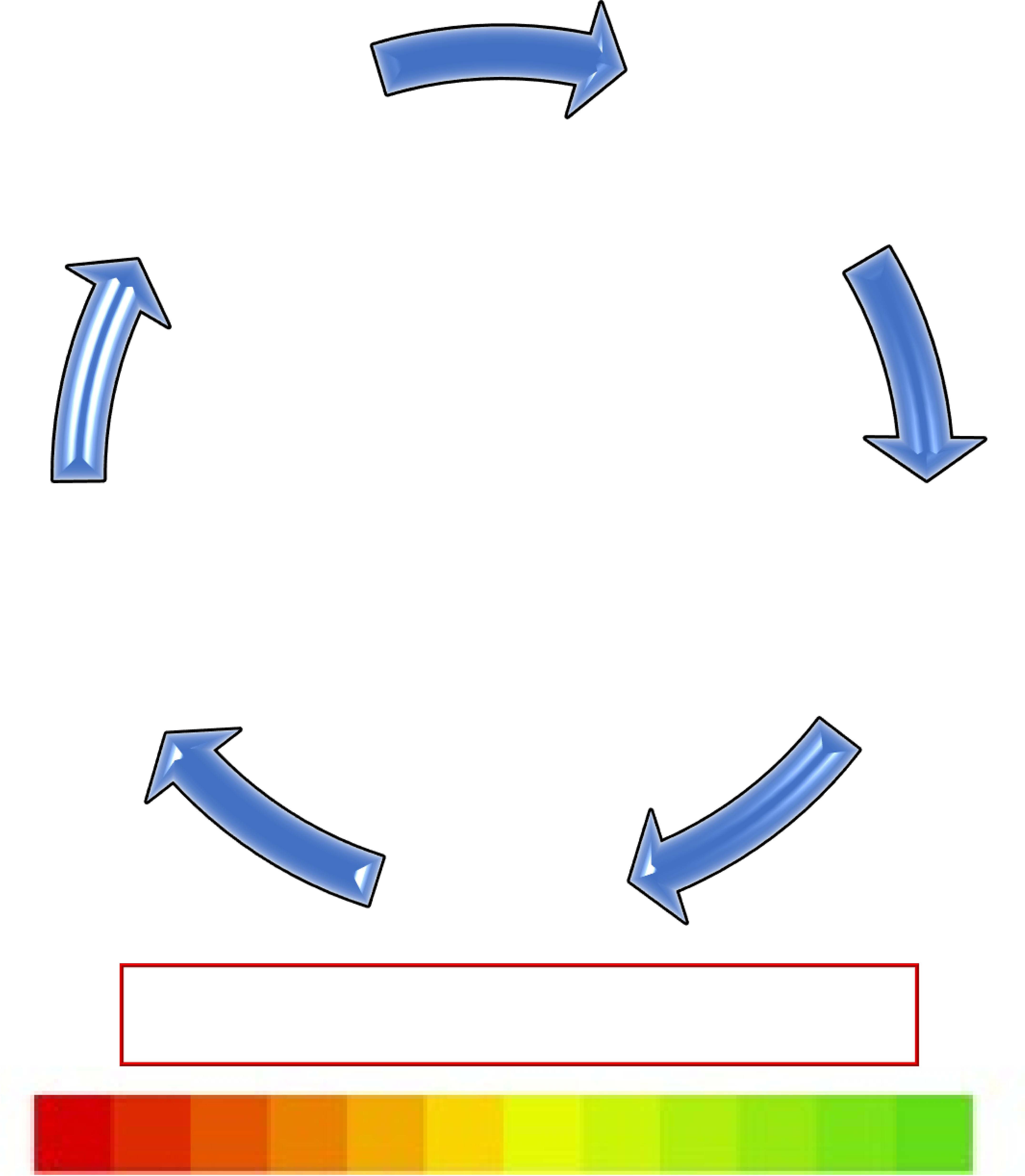
1. Use the framework for the justification of a technology or innovation to deliver medical education.
2. Identify key competences to accomplish.
3. Set up integrating centre and deliver optimally.
4. Identify, accomplish, and measure learning in the 1–3 basic domains.

The matrix helps to operationalise the framework. The framework has specific questions that address the key considera- tions that underscore how effectively an educational technology or innovation is being deployed [or planned] to support teaching and training. Each ASIC tenet has three key questions associated with it, and to which the user of the framework can respond Yes/No. A yes earns a full score of 1 for each question and a No is scored a 0. To help the user, each question has a prompt. There are 12 prompts altogether. The framework can be used manually on paper or digitally. In the paper version [as published in this article], the user can look up the prompt in order to be sure of which response to provide, hence ensuring the accuracy of responses. In the digital version [yet to be published], the user can simply click on the prompt [P] to bring up the prompts. Also, the scores are automatically recorded and presented via a dynamic digital

Advances in Medical Education and Practice 2022:13 **https://doi.org/10.2147/AMEP.S351642**

[DovePress](https://www.dovepress.com/)

**151**



**Figure 3** ASIC Framework Matrix digital result interface. This serves the purpose of a dynamic interface to present the measurements of the matrix in a way that practically helps to appreciate the potential performance of the educational technology or innovations being considered.

**Abbreviations**: A, Adaptation; S, Standardisation; I, Integration; C, Compliance.

interface in the digital version [[Figure 3](#_bookmark38)]; whereas in the manual/paper version, the user is required to manually record the score and compute the final score manually. Also, a worksheet [[Figure 4](#_bookmark39)] is prepared for planning/evaluation purposes. To use the worksheet, the user(s), who might be a faculty member or members of an academic committee, might simply work with the worksheet. Using the prompts as a guide, the worksheet is used to reflect, formulate, and provide specific responses to the requirement under each ASIC tenet. Ability to provide answers to all the requirements would be an indication of optimal deployment of a specific technology or innovation. It should be noted that this provides measurements as such for each technology, not an entire educational system set-up.

##### Prompts

###### A- Adaptation

A1: Do you have time allocated for the use of this technology on your syllabus and/or timetable?

A1 [Alternative]: Did you plan and weighed appropriately the duration of use of the technology?

A2: Can you indicate at least 1 objective that this technology helps you to achieve in connection with your session and/or programme objective?

**152**

**https://doi.org/10.2147/AMEP.S351642**

[DovePress](https://www.dovepress.com/)

Advances in Medical Education and Practice 2022:13



|  |  |
| --- | --- |
|  |  |
|  |  |
|  |  |
|  |  |
|  | |

**Figure 4** ASIC Framework Matrix Worksheet. A worksheet that could help to assess, measure, and document the optimization of medical education technologies and innovations through the operationalization of the ASIC Framework. Using the prompts under each ASIC tenet, educator or institution can reflect and provide concise and concrete answer to each question/requirement.

**Abbreviations**: A, Adaptation; S, Standardisation; I, Integration; C, Compliance.

A3: Can you indicate at least 1 learning outcome that this technology helps you to achieve in connection with your programme objective and/or competency?

###### S- Standardisation

S1: Is there time allocation or unit allocation for the use of the technology in your curriculum?

S2: Do you have a standard and consistent way of using this technology in alignment with course objectives/Do you have a protocol for the use of this technology?

S3: Is your use of this educational technology/ innovation aligned with any specific pedagogy or a learning theory [eg Medical simulation, digital dissection, case based collaborative learning | Constructivism, Connectivism etc.]?

###### Integration

I1: Did you formulate objectives for the use of the technology?



Advances in Medical Education and Practice 2022:13 **https://doi.org/10.2147/AMEP.S351642**

[DovePress](https://www.dovepress.com/)

**153**

I3: Can you identify at least 1 competency in each KSA domain that the use of the technology for your programme [not just course] can help to achieve?

I3: Is the use of the technology in your course/session specifically assessed ie included in the formative or summative assessments?

###### C- Compliance

C1: Is your use of this technology supported by at least 1 specific policy in your institution as a marker of institutional

*compliance*?

C2: Is your use of this technology supported by at least 1 specific policy by your programme regulator as a marker of

*regulatory compliance* [P]

C3: Is your use of this technology supported by the teaching-learning culture of your programme/institution as a marker of *cultural compliance* [P]

In the digitised version of the matrix [which is being developed as a software], each response to the consideration, under an ASIC tenet is calculated and the total is presented as a percentage which is an indication of the operational performance of technology. Another feature of the digitalized version of the matrix is the presentation of the matrix measurements in a graphical form that shows scores per matrix, colour codes each tenet based on performance and presents the overall performance on a colour coded scale bar. This is to give a visual representation of the performance of the innovation of educational technology being measured based on the ASIC Framework. In addition, a failure in any aspect of the tenet is coloured red. The overall measure is presented and accompanied with a comment that could also flag any aspect that requires further consideration to enhance performance. Very importantly, a red colour in an ASIC aspect would mean that the tool is failing under the specific ASIC tenets and as a rule of the thumb, the tool is failing operationality test. The solution is to make corrections to the problem[s] and reuse the matrix again.

##### Guiding Rules

* 1. Optimal performance requires an average of a score of 2.5–3 across all ASIC aspects.
  2. Minimal score of 2 is required in all ASIC aspect.
  3. Score measures potential of operationality; which is achieved when the innovation or technology in question is optimally used as indicated.
  4. Measurement failure, under any of the ASIC tenets/area would mean poor operationality and performance measurements, even with a good overall score; consequently, the area of failure should be addressed until a “pass” score is attained in the category.
  5. The pass score for an ASIC tenet is 2/3 or 0.7.
  6. The overall pass score is 2/3 or ~70%; as an average score across all ASIC areas.

##### ASIC Framework Matrix Worksheet- Based on the Matrix Prompts

The worksheet serves as an extended version of the operationalizing matrix which could help to assess, measure, and document the optimization of medical education technologies and innovations through the operationalization of the ASIC Framework further extensively. In this instance, the worksheet can help individual medical educators, medical education planning or reform committees and other institutional departments to measure how valuable educational technologies and innovations could be to the delivery of medical education. It could serve both an immediate measurement tool as well as a tool for reflective practice in the context of using medical education technologies and innovations.

##### Guide for the Use of the ASIC Framework Matrix Worksheet

1. Consider each ASIC Framework tenet
2. Read each prompt under each ASIC tenet
3. Reflect on the answer to each prompt and formulate a concise and accurate response
4. Record the response against the ASIC Tenet number eg AP1
5. If able to provide a response; a score of 1 [one] allocated

**154**

**https://doi.org/10.2147/AMEP.S351642**

[DovePress](https://www.dovepress.com/)

Advances in Medical Education and Practice 2022:13

1. If no answer is applicable; a score of 0 [zero] is recorded
2. For any question with a score of 0 [as in no. 6 above]; record this ASIC tenet number as a “requirement to fulfil [RF]” during a next review. This is important to improvement and evaluation.

##### Moving Forward

There is continuous effort to conduct usability texts with this framework, particularly under various curricular types of model and educational context and cultures. This would be a way to ensure that the ASIC instruments would adequately meet the need of stakeholders in the medical education and training institutions including students and trainees, educators, and academic leaders. There is always a need to put to test new and emerging educational innovations and innovative approaches to teaching and training;[11](#_bookmark51) so also, the frameworks and other validation and evaluation tools. Efforts such as this should continue as there is a need for significant investment in research and product development to support the development and the integration of technologies into medical education and healthcare. The need to build human capacity in the relevant sectors to these effects have been previously highlighted.[12](#_bookmark52)

It is equally important to highlight the benefits of standardizing the use of EdTechs and innovations to support medical education to students, trainees and learners. Clearly, consistency and methodical deployment of EdTechs and innovation would help to ensure standard practices about the use of such technologies and innovations. Medical education is clearly highly regimented, structured, and standardized, hence, applying these same principles to the use of EdTechs and innovations is equally an important consideration. Consequently, a way to ensure that such best practices are enshrined into the culture of training and learning in medical and allied health institutions is to provide a framework such as the ASIC Framework as well as complementary implementation tool such as its operational matrix to implement such standard and best practices.

It would be important to further advocate for more integral roles of educators in the conception of ideas, design, development, and the deployment strategies to ensure optimal use of educational technologies and innovations. There is a lot more that educators can do in this regard. It is also vital to appreciate the fact that innovations and technologies are becoming increasingly important to the delivery of health services and advancements through research and education. One thing that needs to be emphasised along these lines of development is the need to promote and enshrine a culture of technology use and innovativeness in the systems and institutions that train medical and health workers. Technology, rather than being seen as an optional and complementary tool should be considered an integral tool for cutting edge research and service delivery. Considering these realities, development of tools and instruments, such as the ASIC Framework and its operational matrix [[Figure 2](#_bookmark37)] as well as other strategies to adapt, integrate, standardise, and ensure the best use of innovations and technology in compliance with standard and best practices would significantly contribute to this effort. There is definitely a need to train more tech competent and compliant physicians.[13](#_bookmark53),[14](#_bookmark54) This must start with the educators and medical education stakeholders. There is a need to ensure a tech-supportive culture. Artificial intelligence is currently deployed and promoted in several fields of endeavours because of its immense potentials to shape the ways of life in the nearest future- in all walks of life. Unfortunately, the health care system is yet to adequately grasp this reality and to appreciate the potentials of certain technologies and innovations such as artificial intelligence or AI.[15–18](#_bookmark56) This is just one of the several instances whereby a tech-supported medical education system could be revolutionary. It is a way of preparing for the future of healthcare service delivery.

##### Conclusion

The ASIC framework operational matrix is hereby developed for optimising the use of educational technologies [EdTechs] and innovations in medical education.

This is to ensure that educational technologies and innovation are deployed to deliver medical education in line with identified standards such that they are adapted for optimal performance, standardised for the use of training, integrated into the medical education delivery system, and compliant with professional, institutional, and regulatory standards.

##### Disclosure

The author reports no conflicts of interest in this work.

Advances in Medical Education and Practice 2022:13 **https://doi.org/10.2147/AMEP.S351642**

[DovePress](https://www.dovepress.com/)

**155**

##### References

1. Owolabi J. Proposing a framework guide for the integration of educational technologies and innovations into the teaching of anatomy and medical sciences: the ASIC framework. *Adv Med Educ Pract*. [2021](#_bookmark31);12:1277–1282. [doi:10.2147/AMEP.S338262](https://doi.org/10.2147/AMEP.S338262)
2. Fallavollita P. Innovative technologies for medical education, human anatomy - reviews and medical advances, Alina Maria Sisu. *IntechOpen*. [2017](#_bookmark30). [doi:10.5772/intechopen.68775](https://doi.org/10.5772/intechopen.68775)
3. Santana EA, Orquera PA, Valenzuela JJ, Orellana MI, Gold MH, De La Paz Garcia G. Anatomical software as a tool in the teaching-learning process of human anatomy. Literature review. *FASEB J*. 2020;34(S1):1. [doi:10.1096/fasebj.2020.34.s1.09262](https://doi.org/10.1096/fasebj.2020.34.s1.09262)
4. Zargaran A, Turki MA, Bhaskar J, Spiers H, Zargaran D. The role of technology in anatomy teaching: striking the right balance. *Adv Med Educ Pract*. [2020](#_bookmark1);11:259–266. [doi:10.2147/AMEP.S240150](https://doi.org/10.2147/AMEP.S240150)
5. Zhao J, Xu X, Jiang H, et al. The effectiveness of virtual reality-based technology on anatomy teaching: a meta-analysis of randomized controlled studies. *BMC Med Educ*. [2020](#_bookmark1);20:127. doi:10.1[186/s12909-020-1994-z](https://doi.org/10.1186/s12909-020-1994-z)
6. Dawidziuk A, Kawka M, Szyszka B, Wadunde I, Ghimire A. Global access to technology-enhanced medical education during the COVID-19 pandemic: the role of students in narrowing the gap. *Glob Health Sci Pract*. [2021](#_bookmark1);9(1):10–14. [doi:10.9745/GHSP-D-20-00455](https://doi.org/10.9745/GHSP-D-20-00455)
7. Owolabi J, Bekele A. Implementation of innovative educational technologies in teaching of anatomy and basic medical sciences during the COVID-19 pandemic in a developing country: the COVID-19 silver lining? *Adv Med Educ Pract*. [2021](#_bookmark32);12:619–625. PMID: 34135653; PMCID: PMC8197662. [doi:10.2147/AMEP.S295239](https://doi.org/10.2147/AMEP.S295239)
8. Millan J, Yunda L, Valencia A. Analysis of economic and business factors influencing disruptive innovation in telehealth. *NOVA*. [2017](#_bookmark34);15(28):125–

136. [doi:10.22490/24629448.2136](https://doi.org/10.22490/24629448.2136)

1. Glied S, Lleras-Muney A. Technological innovation and inequality in health. *Demography*. [2008](#_bookmark35);45(3):741–761. [doi:10.1353/dem.0.0017](https://doi.org/10.1353/dem.0.0017)
2. Weiss D, Rydland HT, Øversveen E, Jensen MR, Solhaug S, Krokstad S. Innovative technologies and social inequalities in health: a scoping review of the literature. *PLoS One*. [2018](#_bookmark36);13(4):e0195447. [doi:10.1371/journal.pone.0195447](https://doi.org/10.1371/journal.pone.0195447)
3. Rohlfsen CJ, Sayles H, Moore GF, et al. Innovation in early medical education, no bells or whistles required. *BMC Med Educ*. [2020](#_bookmark40);20(1):39. doi:10.1[186/s12909-020-1947-6](https://doi.org/10.1186/s12909-020-1947-6)
4. Qian Z-W, Huang G. Human capital and innovation ability in medical education: an empirical study. *Eurasia J Math Sci Technol Educ*. [2017](#_bookmark41);13 (8):5395–5403.
5. Shaw N. Medical education & health informatics: time to join the 21st century? *Stud Health Technol Inform*. [2010](#_bookmark42);160(1):567–571.
6. Webster PC. Curricula reform needed to develop more tech-savvy physicians. *CMAJ*. [2011](#_bookmark42);183(10):E621–E622. [doi:10.1503/cmaj.109-3913](https://doi.org/10.1503/cmaj.109-3913)
7. Wartman SA, Combs CD. Medical education must move from the information age to the age of artificial intelligence. *Acad Med*. [2018](#_bookmark43);93:1107– 1109. [doi:10.1097/ACM.0000000000002044](https://doi.org/10.1097/ACM.0000000000002044)
8. Masters K. Artificial intelligence in medical education. *Med Teach*. 2019;41(9):976–980. [doi:10.1080/0142159X.2019.1595557](https://doi.org/10.1080/0142159X.2019.1595557)
9. Chan KS, Zary N. Applications and challenges of implementing artificial intelligence in medical education: integrative review. *JMIR Med Educ*. [2019](#_bookmark10);5:e13930. [doi:10.2196/13930](https://doi.org/10.2196/13930)
10. Wood EA, Ange BL, Miller DD. Are we ready to integrate artificial intelligence literacy into medical school curriculum: students and faculty survey. *J Med Educ Curr Dev*. [2021](#_bookmark10);8:1–5. doi:10.1[177/23821205211024078](https://doi.org/10.1177/23821205211024078)

Advances in Medical Education and Practice

**Publish your work in this journal**

[Dovepress](https://www.dovepress.com/)

Advances in Medical Education and Practice is an international, peer-reviewed, open access journal that aims to present and publish research on Medical Education covering medical, dental, nursing and allied health care professional education. The journal covers undergraduate education, postgraduate training and continuing medical education including emerging trends and innovative models linking education, research, and health care services. The manuscript management system is completely online and includes a very quick and fair peer-review system. Visit <http://www.dovepress.com/testimonials.php> to read real quotes from published authors.

**Submit your manuscript here:** <http://www.dovepress.com/advances-in-medical-education-and-practice-journal>

**[](https://www.facebook.com/DoveMedicalPress/)[](https://twitter.com/dovepress)[](https://www.linkedin.com/company/dove-medical-press)[](https://www.youtube.com/user/dovepress)156**

[DovePress](https://www.dovepress.com/) Advances in Medical Education and Practice 2022:13

**Interdisciplinary Journal of Virtual Learning in Medical Sciences**

**Commentary**

### The ASIC Framework: An Alternative Operational Matrix to Support the Technology and Innovations in Medical Education based on the Primary Learning Domains

[](https://orcid.org/0000-0003-2880-9701)Joshua O Owolabi1\*, PhD

*1Department of Anatomy, Division of Basic Medical Science University of Global Health Equity Kigali Heights, Rwanda, Africa*

ABSTRACT

Educational technology and innovations as well as creative approaches to teaching, learning, and training have become increasingly integral to the delivery of medical education. Arguably, the COVID-19-related challenges of the years 2020-2022 would mark a watershed point in terms of the integration of digital technology and innovations into education, especially medical education. This article presents an operational matrix, aligned with learning in the primary domains, namely cognitive, psychomotor, and effective domains, to support the medical education-associated technology and innovations. It is therefore named the ASIC-CPA operational matrix or the alternative ASIC Framework operational matrix relative to the originally developed and published matrix. Accordingly, the ASIC Framework has been developed, as a foremost instrument to ensure the adaptation, standardisation, and integration of technology in compliant ways. An operational tool or matrix is conducive to ensuring that this ASIC Framework could be used in the most beneficial ways. This article presents an operational matrix that has been developed with emphasis on how EdTech and innovations influence learning in the domains of knowledge or the cognitive, skill-related, or psychomotor and attitude or the affective. Utilizing this tool, technology operators can specifically align their use of educational technology and innovations with learning in these basic domains.

\**Corresponding author:* Joshua O Owolabi, PhD; Department of Anatomy, Division of Basic Medical Science University of Global Health Equity Kigali Heights, Rwanda, Africa

**Tel:** +277 81164365

[**Email:** jowolabi@ughe.org](mailto:jowolabi@ughe.org)  *Please cite this paper as:* Owolabi JO. The ASIC Framework: An Alternative Operational Matrix to

Support the Technology and Innovations in Medical Education based on the Primary Learning Domains. Interdiscip J Virtual Learn Med Sci.

2022;13(2):141-147.doi:10.30476/

IJVLMS.2022.94592.1139.

Received: 9-3-2022

Revised: 23-3-2022 Accepted:7-4-2022

**Keywords:** Educational innovation, Edtech, Education, Medical, ASIC framework, ASIC matrix, Adaptation, Reference standards, Integration, Compliance

Introduction

The roles of educational technology and innovations in medical education seem to continue to be more critical and integral; that is because it appears that many stakeholders have come to appreciate the potential benefits of technology much more than ever before. A key consideration, which is more like a fallout from the massive integration of technology

and innovations, is the need to optimise their use. Understandably, certain stakeholders and regulators might not have been adequately prepared for the current level of technology use to support medical education. The same might be applicable to some academic leaders and educators as well as learners and trainees. The ASIC Framework was developed to provide a much-needed framework to help

*Interdisciplinary Journal of Virtual Learning in Medical Sciences (IJVLMS) is licensed under a Creative Commons Attribution- NoDerivatives 4.0 International License. https://creativecommons.org/licenses/by-nd/4.0*

educators and medical education stakeholders to adapt, standardise, and integrate the use of innovations and educational technology in the delivery of medical education (1). The use of innovations and educational technology has considerably increased on account of a number of reasons, including advancements in education, with specific emphasis on medical education (1) and the COVID-19 pandemic and its syndemic effects (2, 3).

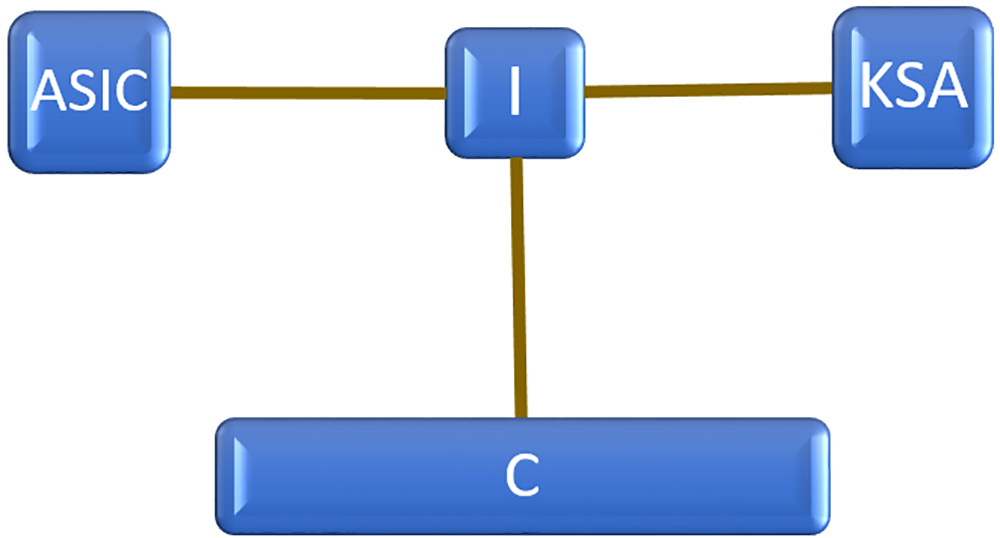
The ASIC Framework was published as a foremost framework guiding the introduction and optimal utilisation of educational technology and innovations in the context of medical education. The question arises based on the fact that different stakeholders and institutions have designed and developed or adopted and deployed various medical education-associated technology in a way that they probably deemed the best possible and the most effective. Educational technology and innovations have become increasingly integral and important to the delivery of medical education and training (4-7). It is important to appreciate the fact that medical education is highly regulated, with emphasis on benchmarks and standard practices. This is simply to ensure that, irrespective of the training institution, medical practitioners and health workers possess the requisite skills that can make them provide people with the services required in the best possible ways. This will therefore justify the need for a framework concerning educational technology and innovations, which could be used to support the delivery of medical education. Additionally, educational technology and a high number of innovations are relatively new and heterogeneous in terms of types and the needs that they can satisfy. Additionally, EdTech [or educational technology], might not only refer to the collection of technologies that support learning and teaching but also the paradigm and practices that address the development and use of such technology. This subject is rapidly evolving. Moreover, system factors [organisational setup, culture, and practices], as well as preferences, could make significant

differences in terms of choices of what educational technology and innovations could be used. Furthermore, such attempt to extensively regiment the use of educational technology and innovations in medical education is not in line with the tech culture. On top of several other values and benefits, technology brings results in flexibility, creativity, and dynamic deployment (8, 9). What is however important is the need to provide framework[s] and standard guide[s] to ensure that, irrespective of the educational technologies and innovations that might be employed, they are used in the most effective, educationally compliant, and in evidence- based ways, following the best practices, and in accordance with the philosophy of medical education, curricula requirements, and learning objectives.

There is a methodical approach to this work. However, unlike conventional research that follows established methods or protocols, innovations and creative works often follow a well-defined, but de novo conceptual approach. In this instance, the approach involves a number of steps which constitute a series of carefully constructed phases, including: (1). identification and definition of the problem or challenge; (2). obtaining evidence to support an approach; (3). creating a framework to address the problem; (4). generating an operational model to use the framework; (5). obtaining data through the use of framework and matrix to gather evidence for advancement and to influence better future practices. This is similar to a previous approach that was used to develop the SimZones framework (10, 11). While these phases give the big picture within which context this publication is situated, the publication of the ASIC Framework operational matrix aligns with the Phase 4 (Figure 1).

*ASIC Framework CPA Matrix: Creating an Alternative Matrix and Worksheet*

ThealternativeASICFramework,alsocalled the ASIC-CPA matrix, considers the ASIC tenets in the contexts of the curriculum [C],



**Figure 1:** ASIC Framework. A framework for guiding medical educators and stakeholders towards adaptation, standardisation, and integration of EdTech and innovations while ensuring compliance with institutional, professional, and regulatory standards. An adaptation of the original ASIC Framework as adapted from the original publication (1).

pedagogy [P], and assessment [A]. This approach considers three basic parameters, which primarily determines how well educational technology or innovation is being deployed to deliver medical education. It is still in line with the ASIC Framework whereby the four tenets are being considered relative to the key determining factors of delivery, including curriculum, pedagogy, and assessment (Figure 2). It also has a digital interface prototype (Figure 3).

The alternative ASIC Framework operational matrix works with the same principle as the original matrix. For the sake of clarity and consistency, following part contains an excerpt from the publication on the original framework:

**Excerpt:** The use of the ASIC Framework and its guiding rules (1).

1. Optimal performance requires an

average score of 2.5-3 across all ASIC aspects.

1. The minimal score of 2 is required in all ASIC aspects.
2. The score measures the potential of operationality which is achieved when the innovation or technology in question is optimally used as indicated.
3. Measurement failure, under any of the ASIC tenets/areas would mean poor operationality and performance measurements, even with a good overall score; consequently, the area of failure should be addressed until a ‘pass’ score is attained in the category.
4. The pass score for an ASIC tenet is 2/3

0r 0.7.

1. The overall pass score is 2/3 or ~70%,

as an average score across all ASIC areas.

Arguably, much more than ever before, efforts are now made to promote the integration of simulation (12), artificial intelligence, EdTech, and telemedicine facilities into medical training. Standalone technology and applications are also being developed and deployed. Some of these include the Anatomage table, high fidelity mannequins, the google glass, the magic mirrors, and others. In addition, there are virtual patients and software, such as the Zygote and the Complete 3D software to teach anatomy, using a digital human. Individual medical educators and teams have reported their experiences, with several reporting significant successes and positive impacts on learning outcomes with the use of technology and innovations

(13). We therefore have immense evidence on the benefits of technology and innovations to medical education (14).

What stakeholders in medical education now need to ensure, is that standard and best practices are adhered to. This would mean that these innovations and this technology are helping to accomplish medical education competencies as intended and defined in programmed outcomes. In addition, they should also be used to provide effective benefits in the attitude domain of learning by helping train tech-inclined, tech competent, and tech compliant future doctors, noting that the future of work is predictably tech- complaint, tech-savvy, and technophilia. The latter is used to describe a situation whereby doctors and health workers embrace and utilize technology optimally. This would be in contrast to the current scenario where in certain instances, health workers, trained under the old paradigm, might exhibit tecnophobia (a term used to refer to being, tech-averse or tech-incompetent). Technophobia is not just incongruent with the anticipated future culture of work and medical practice. Meanwhile, it could also slow down the progress that medical education and

**The ASIC Framework CPA Matrix and Prompts**

|  |  |
| --- | --- |
| **A- Adaptation** | **S- Standardisation** |
| **C-A1**. Use of technology/innovation indicated in curriculum/syllabi – *there is specified time/period/duration for use* [P]  [Yes | No ] **P-A2**. The use of technology or innovations are used to achieve stated learning objectives- *there is an objective statement* [P]  [Yes | No ] **A- A3**. Impact of technology or innovation on learning outcome is measured with formative/summative assessments - *learning outcome identified and assessed* [P]  [Yes | No ]  [2-out of-3 or 66.6%] | **C- S1**. Time allocation on curriculum/syllabi- there is a specific *time/period allocated for use* [P]  [Yes | No ]  **P- S2**. Method of use is pre-determined and a protocol or guide for use is prepared- *methodical guide or a protocol is available* [P]  [Yes | No ] **A- S3**. Alignment with specific objective that is also measured or assessed- *specific objective[s] are aligned with assessment* [P]  [Yes | No ]  [2-out of-3 or 66.6%] |
| **I- Integration** | **C- Compliance** |
| **C-I1**. Specific competencies to achieve with technology/innovation identified in curriculum or syllabus– *Session delivery contributes to specific competencies* [P]  [Yes | No ] **P- I2**. The use of the technology or innovations aligns with known pedagogy or pedagogical principles- *pedagogy is defined, and lesson is planned* [P]  [Yes | No ] **A- I3***.* Assessment of learning with innovation or technology contributes to final measure of training impacts e.g. final assessments or grades- *assessment of learning or performances with EdTech/innovation is measured.*  [Yes | No ]  [2-out of-3 or 66.6%] | **C- C1**. The use of technology or innovation aligns clearly with identified curriculum philosophy and/or objective- *There is evidence of institutional compliance* [P]  [Yes | No ]  **P- C2**. There is a learning theory or a pedagogical principle that supports the methods – *There is evidence of regulatory compliance* [P]  [Yes | No ] **A3- C3**. Assessment of technology or innovations impacts on learning aligns with institutional and/or regulatory practices. *– There is evidence of cultural compliance* [P]  [Yes | No ]  [2-out of-3 or 66.6%] |
| **Total** | |
| **Prompts [P]:** | |
| **A- Adaptation**  **C- A1**: Is this technology/innovation clearly indicated as a learning tool/facility in your curriculum, or syllabus or lesson plans?  **P- A2**: Is the use of the technology or innovation aligned with specifically stated learning objective[s]?  **A- A3**: Is there an indicated assessment method that is used to measure the impact[s] of technology or innovation use on  learning outcome, as measured with formative/summative assessments? | |
| **S- Standardisation**  **C- S1**: Is there a specific time allocation or unit allocation for the use of the technology in your curriculum or syllabus?  **P- S2**: Is there a planned or standardised method of using the technology or innovation. e.g. learning protocol or learner’s guide?  **A- S3**: Is the technology or innovation as used involved in the formative or summative assessments? | |
| **I- Integration**  **C- I1**: Is there any specific competencies to achieve with the technology/innovation as indicated in the curriculum or syllabus?  **P- I3**: Is the use of the technology or innovations in alignment with known pedagogy or pedagogical principles?  **A- I3***.* Is there an assessment of learning with innovation or technology that contributes to measures of training impacts? | |
| **C- Compliance**  **C-C1**: Is the use of the technology or innovation in alignment with identified institutional curriculum philosophy and/or objective?  **P-C2**: Is there is a learning theory, pedagogical principle or a professional practice that supports the use of the technology or innovations?  **A- C3**: Is the use of the technology or innovations and its impacts on learning in alignment with programme and/or  regulatory requirements as measures of competences. [P] | |

**Figure 2:** ASIC Framework alterative matrix. The alternative ASIC Framework or the ASIC-CPA Matrix considers the ASIC tenets in the contexts of the Curriculum [C], Pedagogy [P], Assessment [A].

best strategy to deploy medical simulation in the training of students and medical professionals

S I

(10). The guide defines simulation into zones. It provides the attributes of each zone as well as how simulation could be performed to suit different categories of trainees based on the training requirements as well as the level of the trainee. This guide, which has been successfully used at the Harvard Medical School and Boston Children’s Hospital, is one of the outstanding efforts that also buttresses the fact that there is a need to provide frameworks and guides to ensure that medical education technology and innovations are deployed in standardised, integrated, educationally valid, and compliant ways following the best practices. Medical educators need adequate resources and supportive systems in their efforts to use technology and innovations; this



T

**TOTAL=**

A C

**Figure 3:** ASIC Framework Matrix result interface. A prototype of the display inter-face for the results of the use of the ASIC matrix to measure the performance of an educational technology or innovation. The alternative ASIC Framework Operational Matrix works with the same principle as the original matrix [A= Adaptation; S= Standardisation; I= Integration; C= Compliance; T= Total score].

practice could make through the contributions of technology if it is not addressed. The future will need doctors and health workers who appreciate EdTech, and can work with simulations, artificial intelligence (15-18), robot-supported practices, such as robotic surgery, development, and the use of medical algorithms, and telemedicine practices (19, 20). This is another main reason why technology and innovations should become integrated into the training programs.

The ASIC Framework is not essentially the only effort that has been made to ensure that the standards and best practices are enshrined in the tech culture of medical education; for example, Harvard University and Boston Children Hospital medical educators and trainers developed the medical simulation guide, called SimZones (10, 11), which has become quite popular. The SimZones guide was developed to guide institutions, such as medical schools and training hospitals, on the

could add value to human capacity in medical education (21).

It is worthy of note that the ASIC Framework and its alternative matrix could be adapted to almost any type of educational technology and innovations towards ensuring the optimal use of such technology and innovations. The fact that the framework has a practical operational matrix makes its use practical as objective as possible. This framework and matrix could have a significant and positive impact on shaping the best strategy to deploy technology and innovations. In addition, it could guide designers and developers of EdTech products in their efforts to ensure that their products best meet the need of leaners, educators and training institutions.

Conclusion

The development of the ASIC Framework operational matrix is an advancement over the original ASIC Framework. It provides a quality measure of the effectiveness of a technology or innovation. Medical educators and stakeholders can therefore employ the operational matrix to support their efforts to deploy and optimise the use of EdTech and innovations.

**Conflict of Interest:** None declared.

References

1. Owolabi J. Proposing a Framework Guide for the Integration of Educational Technologies and Innovations into the Teaching of Anatomy and Medical Sciences: The ASIC Framework. Adv Med Educ Pract. 2021;12:1277-1282. doi:10.2147/AMEP.S338262.
2. Horton R. Offline: COVID-19 is not a pandemic. Lancet. 2020; 396:874. doi: 10.1016/S0140-6736(20)32000-6.
3. Hulvej-Rod M, Hulvej-Rod N. Towards a syndemic public health response to COVID-19. Scand J Public Health. 2021; 49:14–16. doi: 10.1177/1403494820982862.
4. Santana EA, Orquera PA, Valenzuela JJ, Orellana MI, Gold MH, De La Paz Garcia G. Anatomical software as a tool in the teaching-learning process of human anatomy. Literature review. FASEB J. 2020;34:1. doi:10.1096/fasebj.2020.34. s1.09262.
5. Zargaran A, Turki MA, Bhaskar J, Spiers H, Zargaran D. The role of technology in anatomy teaching: striking the right balance. Advan Med Educ Pract. 2020;11:259–266. doi:10.2147/AMEP. S240150.
6. Zhao J, Xu X, Jiang H, et al. The effectiveness of virtual reality-based technology on anatomy teaching: a meta- analysis of randomized controlled studies. BMC Med Educ. 2020;20:127. doi:10.1186/ s12909-020-1994-z.
7. Dawidziuk A, Kawka M, Szyszka B, Wadunde I, Ghimire A. Global access to technology-enhanced medical education during the COVID-19 pandemic: the role of students in narrowing the gap. Glob Health Sci Pract. 2021;9(1):10–14. doi:10.9745/GHSP-D-20-00455.
8. Moran J, Briscoe G, Peglow S. Current Technology in Advancing Medical Education: Perspectives for Learning and Providing Care. Acad Psychiatry. 2018; 42:

796–799. doi:10.1007/s40596-018-0946-y.

1. Han ER, Yeo S, Kim MJ et al. Medical education trends for future physicians in the era of advanced technology and

artificial intelligence: an integrative review. BMC Med Educ. 2019; 19:460. doi:10.1186/s12909-019-1891-5.

1. Roussin CJ, Weinstock P. SimZones: An Organizational Innovation for Simulation Programs and Centers. Acad Med. 2017;92(8):1114-1120. doi: 10.1097/ ACM.0000000000001746. PMID: 28562455.
2. Roussin C, Sawyer T, Weinstock P. Assessing competency using simulation: the SimZones approachBMJ Simulation and Technology Enhanced Learning 2020;6:262-267.
3. Motola I, Devine LA, Chung HS, Sullivan JE, Issenberg SB. Simulation in healthcare education: a best evidence practical guide. AMEE Guide No. 82. Med Teach. 2013; 35(10):e1511-30. doi: 10.3109/0142159X.2013.818632. PMID:

23941678.

1. Linderman SW, Appukutty AJ, Russo MV et al. Advancing healthcare technology education and innovation in academia. Nat Biotechnol. 2020; 38**:**1213–1217. doi. org/10.1038/s41587-020-0689-7.
2. Fallavollita P. Innovative Technologies for Medical Education, Human Anatomy

- Reviews and Medical Advances, Alina Maria Sisu, IntechOpen. 2017. doi: 10.5772/intechopen.68775. Available from: https://[www.intechopen.com/](http://www.intechopen.com/) chapters/55203.

1. Wartman, SA, Combs, CD. Medical education must move from the information age to the age of artificial intelligence. Acad Med. 2018;93:1107-1109.
2. Masters K. Artificial intelligence in medical education. Med Teach. 2019;41:976-980.
3. Chan KS, Zary N. Applications and challenges of implementing artificial intelligence in medical education: integrative review. JMIR Med Educ. 2019;5:e13930.
4. Wood EA, Ange BL, Miller DD. Are We Ready to Integrate Artificial Intelligence Literacy into Medical School Curriculum: Students and Faculty

Survey. Journal of Medical Education and Curricular Development. 2021; doi:10.1177/23821205211024078

1. Shaw N. Medical education & health informatics: time to join the 21st century? Stud Health Technol Inform. 2010;160(Pt 1):567-71. PMID: 20841750.
2. Webster PC. Curricula reform needed to develop more tech-savvy physicians.

CMAJ: Canadian Medical Association journal ( journal de l’Association medicale Canadienne) 2011; 183(10): E621–E622.

doi:10.1503/cmaj.109-3913.

1. Qian Z-W, Huang G. Human Capital and Innovation Ability in Medical Education: An Empirical Study. EURASIA Journal of Mathematics Science and Technology Education. 2017; 13(8):5395-5403.

ASIC Framework for EdTech Optimisation

### Joshua O. Owolabi

###### About the Idea

About ASIC Framework: Excerpt

The use of innovations and educational technologies or EdTech has become integral to medical education, and advancement in healthcare. Currently, EdTech variants are quite diverse, with significant variations in EdTech penetration and qualities of deployment from place to place. Through experience, observations, research and synthesis of evidence, four key considerations for optimizing innovations and educational technologies [EdTech] when used for medical and higher education [MedEd] have been established as follows- adaptation, standardization, integration and compliance [ASIC]. The instrument has been named ASIC Framework which can be practically applied using its operational matrix. Subsequently, the ASIC Framework has become a foremost instrument for *assuring* innovation and EdTech’s optimisation for medical education, health science education and by extension, higher education. Maladaptation of a new technology might be significantly counterproductive just as lack of standardization might be problematic as it causes heterogeneities. Also, poor integration might make the use of an innovation negatively disruptive. Lack of compliance might introduce extreme relativism in EdTech use philosophy, and unethical practices. The ASIC Framework was originally developed, published and presented to the communities of practice. Also, a practical guide named ASIC Framework Operational Matrix was published to aid the practical use of the framework. Subsequently, this matrix has been digitalized and made available in the form of a web-hosted app, hence, an innovative product that could be patented. The ASIC Framework could be very useful to key stakeholders in medical education including educators, institutions and regulators. Ultimately, it could generally and universally help to optimize the use of technologies and innovations for medical education and training, and by extension, higher education.

2024

Department of Biomedical Sciences, PCOM South Georgia,

2050 Tallokas Road,

Moultrie, GA 31768.

7th August, 2024.

The Provost, SVP for Academic Affairs, Philadelphia College of Osteopathic Medicine, Philadelphia, Pennsylvania.

USA.

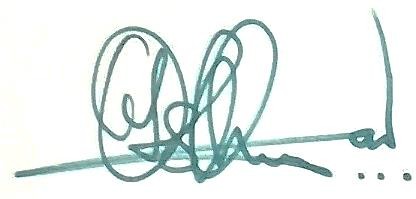
Dear Dr. Veit,

Re: A Decision About my Invention Named ASIC Framework for EdTech Optimization

I write to request a decision about my invention named: ASIC Framework for EdTech Optimization, that was submitted to the Philadelphia College of Osteopathic Medicine in May 2024, especially indicating PCOM’s position about the ownership of the invention and submission of a provisional patent application.

I specially appreciate you and the leadership of the PCOM for the attention given to my submission. I have benefited from the enriching conversations and critique of the idea and the actual product that I am presenting for a patent. Altogether, I greatly appreciate the thoroughness of the PCOM process of consideration and the positive disposition of all stakeholders and university officials, including yourself as the Provost and SVP for Academic Affairs, Dr. George- Weinstein as the PCOM Chief Research Science Officer, and the team that was set up to review the submission during my presentation. I am also very grateful to the President, Dr. Feldstein.

Thank you very much, sir.



**Joshua O. Owolabi** | MSc., MMedEd, MBA, PhD, PhD, FAcadMEd Associate Professor

Anatomy, Neuroscience & Histology